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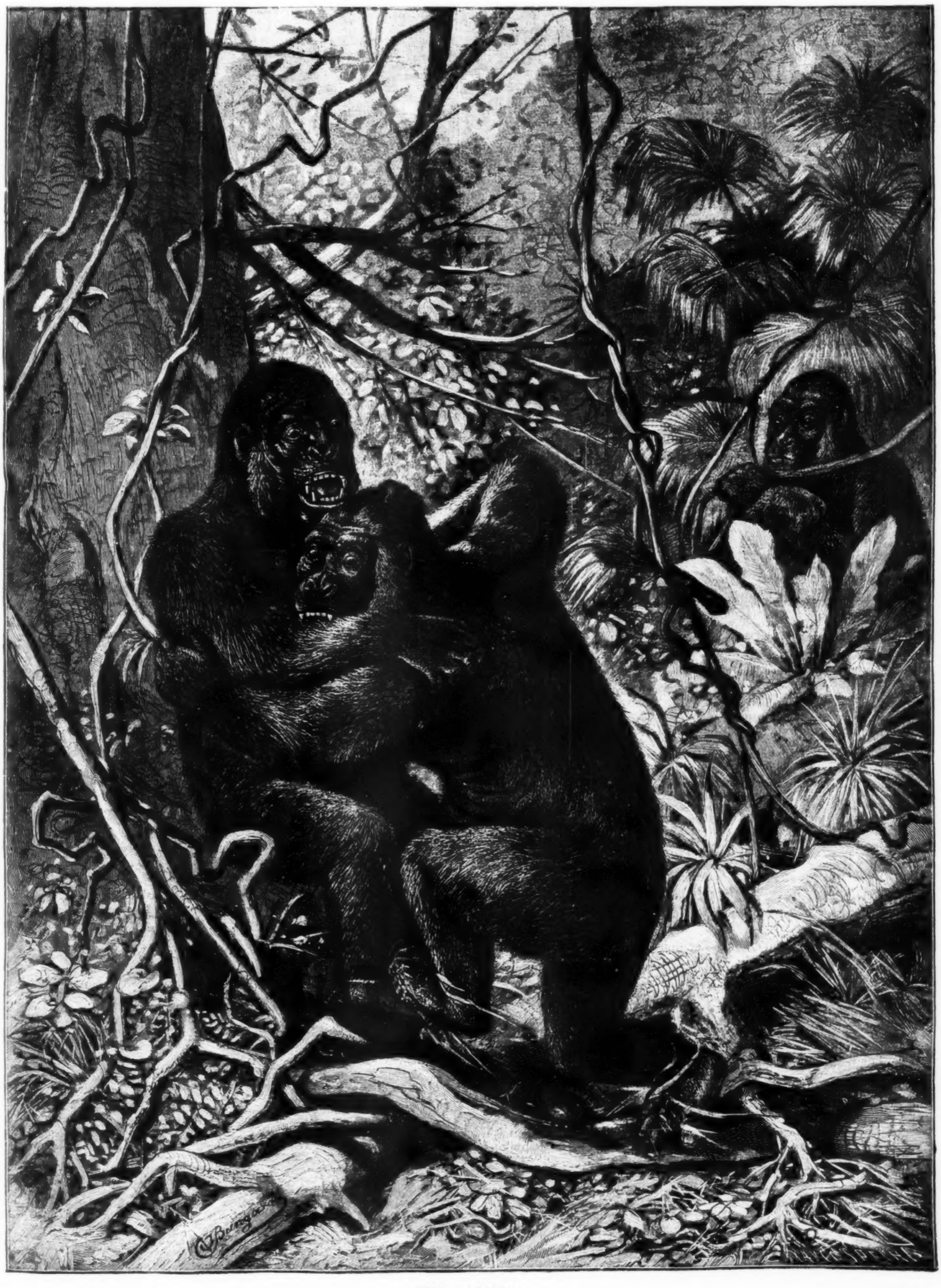

THE GORILLA.

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THE word "anthropoid," signifying "manlike," has been applied to the apes who, in their general appearance, most resemble the human race. The chimpanzee, orang-outang and gorilla are the three great anthropoids, and of these the most impressive, from the almost romantic descriptions of it by the naturalists, is the gorilla. It possesses the honor of having been first introduced to the scientific world by an American naturalist. It was in 1847 that Dr. F. S. Savage, in the Boston Journal of Natural History, describes its character and habits, while its osteology was given by Prof. Jeffries Wyman.

At first it was placed in the same genus with the more intelligent chimpanzee, but later, in 1852 and 1853, it was assigned a genus to itself, as the gorilla, by the French naturalist, Geoffroi St. Hiliare, although it would seem entitled to be named after the original describer, Dr. Savage. This has not been done.

The male adult gorilla is from 5 to 6 ft. high. Were its legs of anything like the proportion of man's legs and strength, it would have exceeded in height any member of the human race, as its head, neck, body and arms surpass in size those of man. Its strength is described as enormous. Du Chaillu describes it as eviscerating one of its native attendants by a single blow, and it is said that it can crush a gun barrel with its teeth. Its hands and feet would seem adapted to tree climbing, yet it is essentially a surface living animal, clumsily making its way over the ground, sometimes resting on the outsides of its clinched fingers and swinging its body and legs between them like parallel bars in its advance.

It is a native of the west coast of Africa, especially inhabiting the thickly wooded districts of the interior. All sorts of stories have been told of it; of its carrying off women from the villages, and of its arming itself with clubs, but these are purely fictitious. In spite of its possession of most powerful hands, it does not seem to realize any use of the most primitive weapons.

Our engraving represents a fight between two members of the gorilla tribe, the results watched by a third one partly hidden in the bushes. Recently there have been in captivity in this country two very good examples of the animal, male and female, which carried out the descriptions of strength given by those who have studied them in their own country.

MOSQUITOES AND FLEAS.

I.—MOSQUITOES.

WE are accustomed to think of but a single species of mosquito, and of this as occurring in most parts of the country, but as a matter of fact, Osten Sacken's Catalogue of the Diptera records twenty-one species from North America, and Mr. F. W. Urich states that he has observed at least ten species in Trinidad. Twenty species are contained in the collection of the United States National Museum.

The following statement concerning the life history of these insects is based upon a series of observations made in this division upon the development of two summer generations of Culex pungens, one of our commonest and most widespread species. The writer has seen specimens of this insect from New Hampshire, Massachusetts, New York, Maryland, District of Columbia, Illinois, Minnesota, Kentucky, Nebraska, Louisiana, Georgia, and the island of Jamaica, West Indies. No doubt it is also abundant in New Jersey.

Egg laying takes place at night. The eggs are deposited in boat shaped masses on the surface of the water, the number varying from 200 to 400 in each mass. The eggs may hatch in sixteen hours. The larvæ live beneath the surface of the water, coming to the top at frequent intervals to breathe. The larval state may be completed in seven days; the pupal state may last only twenty-four hours. An entire generation in summer time, then, may be completed in ten days. This length of time, however, may be almost indefinitely enlarged if the weather be cool. There are, therefore, many generations in the course of a season and the insect may breed successfully in a more or less transient surface pool of water.

Mosquitoes hibernate in the adult condition in cellars and outhouses and under all sorts of shelter. The degree of cold makes no difference in successful hibernation; mosquitoes are abundant in the Arctic regions.

REMEDIES.

Of remedies against mosquitoes in houses the best is a thorough screening of windows and the placing of nets about beds. If the insects are troublesome in sitting or sleeping rooms during the evening, the burning of pyrethrum will so stupefy them as to make their presence unobjectionable. Pyrethrum for this purpose should be prepared by moistening the powder sufficiently to allow of its being roughly moulded by hand into little cones about the size and shape of a large chocolate drop. These cones are then placed in a pan and thoroughly dried in an oven. When fired at the apex, such a cone will smoulder slowly, and send up a thin column of pungent smoke, not hurtful to man, but stupefying to mosquitoes. In actual experience two or three such cones burned during the course of an evening have given much relief from mosquitoes in sitting rooms. It does not kill the insects, however, and is at best but a palliative.

The mosquitoes found on the ceilings of bedrooms in the evening may be quickly and easily killed by means of a small, shallow tin cup (such as the lid of a blacking box) nailed to the top of a stick and wet inside with kerosene. This cup is placed over the quiescent mosquito, which immediately drops or flies against the oily surface and is killed. But altogether the most satisfactory means of fighting mosquitoes are those which are directed to the destruction of the larvæ or the abolition of breeding places. These measures are not everywhere feasible, but in many places there is absolutely no necessity for the endurance of the mosquito plague. The principal remedies of this class are three: The draining of ponds and marshes, the introduction of fish into fishless pools, and the use of kerosene on the surface of the water.

The draining of breeding pools needs no discussion. Obviously the drying up of such places will prevent mosquitoes from breeding therein, and the conditions of a successful application of this measure will, it is equally obvious, vary with each case.

The introduction of fish into fishless ponds is feasible and advisable in many cases where the use of kerosene on the surface of the water would be thought undesirable. In tanks supplying drinking water, for example, fish would destroy the mosquito larvæ as fast as hatched. A case is recorded in Insect Life (vol. iv, p. 223) where carp were employed in this way with perfect success by an English gentleman living in the Riviera. At San Diego, Tex., the people use for this purpose a little fish, called there a perch, the species of which the writer has not been able to ascertain. Probably the common voracious little stickleback would answer admirably as a mosquito destroyer.

Probably the best, and certainly the easiest, of wholesale remedies against mosquitoes is the application of kerosene to the surface of breeding pools. The suggestion that kerosene could be used as a remedy for mosquitoes is not new and has been made more than once. Exact experiments out of doors and on a large scale were made in 1892 by the writer. These and subsequent experiments show that approximately one ounce of kerosene to each fifteen square feet of water surface on small pools will effectually destroy all the larvæ and pupæ in that pool, with the additional advantage that the adult females, not deterred from attempting to oviposit, are killed when they alight on the kerosene covered water. Ordinarily the application need not be renewed for a month, though varying circumstances may require more frequent applications in certain cases.

Since 1892 several demonstrations, on large and small scales, have been made of the practicability of this method. Under the writer's supervision two localities were rid of mosquitoes by the use of kerosene alone. It will, however, probably not prove feasible to treat in this way the large sea marshes along the coast where mosquitoes breed in hordes, although even here the remedy may prove to be practicable under certain conditions and in certain situations. In inland places, however, where the mosquito supply is derived from comparatively circumscribed pools, the kerosene remedy will prove most useful. In some California towns, we are informed, the pit or vault behind water closets is subject to flushing with water during the irrigation of the land near by. A period of several weeks elapses before more water is turned in, and in the meantime the water in the pit grows stagnant and becomes the breeding place of thousands of mosquitoes. Where, as in certain towns and cities, house drainage runs into such a pit and an outdoor privy with a seldom closed door is built over it, mosquitoes will breed all summer in the fluid contents of the vault and of course will infest all the adjacent houses.

In such cases a teacupful of kerosene poured into each vault at intervals of a month or less would greatly decrease the annoyance from mosquitoes, if it did not altogether prevent it. This is a case where the co-operation of neighbors is most essential; every householder in a given neighborhood should see that his vault is treated with kerosene regularly and often. The cost is so trifling that it need not be considered.

Where, as is the case at many country homes, rain water is collected in barrels or hogsheads, for one purpose or another, mosquitoes may and do breed in numbers in such vessels. If the water as used be drawn from the bottom of the cask, it will do no harm to pour in a little kerosene, since the oil will not be drawn out with the water. At all events, such receptacles should be covered at night to prevent egg laying.

The question, What is the best way to cover with kerosene the surface of a pool of some size, is apparently needless, since the operation is obviously simple, but such a question has been asked of the Division. Simply pouring the oil on from any point of the shore will answer tolerably well, since it will spread of itself, but if for any reason it is desired to coat the pool rapidly with kerosene, it may be advisable to spray the oil through a spraying nozzle, either from the bank or from a boat. The method of application will vary with each case, but in the class of pools which can be most advantageously treated, namely, those of small size, the oil can be well spread by throwing it on to windward with a wide sweep of the arm.

II.—FLEAS.

Judging from the specimens of fleas sent to the Division of late years, with complaints of houses infested by them, the human flea (Pulex irritans) is not the species most likely to occur in great numbers in dwelling houses, but rather the common cosmopolitan flea of the dog and cat (Pulex serraticeps). A house may become infested with this species, even though no domestic animals be kept, for a visitor at a house where such pets are maintained may be the means of carrying home with him one or two female fleas which will stock his own premises. Of course where a pet dog or cat is kept the source of the infestation is manifest.

The worst cases of infestation reported to this Division were where houses had been temporarily unoccupied during the summer. Such houses often become more or less damp, and as a rule the customary sweeping of the floors is interrupted, thus furnishing the very conditions under which, as we shall see, fleas most readily propagate.

The eggs of Pulex serraticeps are deposited among the hairs of cats and dogs, but as they are not attached to the hairs, numbers drop off whenever the infested animal moves or lies down. For experimenters who desire to follow out for themselves the life history of the species, an easy way to collect the eggs is therefore to lay a strip of cloth or carpet for the animal to sleep upon, and afterward to brush the cloth into a receptacle, in which the eggs will be found in numbers if the animal is infested. In this lies a hint for the housekeeper who would keep a pet dog or cat and yet avoid an outbreak of fleas in the house. Provide a rug for the cat or the dog to sleep on and give this rug a frequent shaking and brushing, afterward sweeping up and burning the dust thus removed. As all the flea eggs on an infested animal will not, however, drop off in this way, and those which remain on it will probably develop successfully, it will be found wise to occasionally rub into the hair of the dog or cat a quantity of pyrethrum powder. If thoroughly applied, it will cause the fleas to fall off in a half stupefied condition, when they, too, may be swept up and burned.

In the observations made at this Department upon this species of flea during the summer of 1895, some difficulty was found in preserving just the right degree of moisture to enable the insect successfully to transform. An excess of moisture was found prejudicial to the development of the species, as was too great dryness. The observations showed, however, that at Washington in summer an entire generation may develop in a little more than a fortnight. Hence a housekeeper shutting up her house in June, for example, with a colony of fleas too small to be noticed inside it, need not be surprised to find the establishment overrun when she opens it up again in September or October.

REMEDIES.

The larvæ of the dog and cat flea will not develop successfully in situations where they are likely to be disturbed. The use of carpets and straw mattings, in our opinion, favors their development, since the young larvæ can penetrate the interstices of either sort of floor covering and find an abiding place in some crack where they are not likely to be disturbed. It is comparatively easy to destroy the insect in its early stages (when it is noticed), as is shown by the difficulty of rearing it, but the adult fleas are so active and so hardy that they successfully resist any but the most strenuous measures. Even the persistent use of California buhach and other pyrethrum powders was ineffectual in one case of extreme infestation, as was also, and more remarkably, a free sprinkling of floor matting with benzine. In this instance it was finally necessary to take up the floor coverings and wash the floors down with hot soapsuds in order to secure relief from the flea plague. In another case, however, a single liberal application of buhach was perfectly successful, while in a third a single thorough application of benzine completely rid an infested house of fleas.

To sum up: Every house where a pet dog or cat is kept may become seriously infested with fleas if the proper conditions of moisture and freedom from disturbance exist. Infestation, however, is not likely to occur if the (bare) floors can be frequently and thoroughly swept. When an outbreak of fleas comes, however, the easiest remedy to apply is a free sprinkling of pyrethrum powder in the infested rooms. This failing, benzine may be tried, a thorough spraying of carpets and floors being undertaken, with the exercise of due precaution in seeing that no lights or fires are in the house at the time of the application, or for some hours afterward. Finally, if the plague is not thus abated, all floor coverings must be removed and the floors washed with hot soapsuds. This is a useful precaution to take in any house which it is proposed to close for the summer, since even a thorough sweeping may leave behind some few flea eggs from which an all-pervading swarm may develop before the house is reopened. L. O. HOWARD, Entomologist.

—Circular U. S. Department of Agriculture.

THE LAW WHICH UNDERLIES PROTECTIVE COLORATION IN ANIMALS.*

THIS article is intended to set forth a beautiful law of nature which, so far as I can discover, has never been pointed out in print. It is the law of gradation in the coloring of animals, and is responsible for most of the phenomena of protective coloration except those properly called mimicry. Naturalists have long recognized the fact that the coloring of many animals makes them difficult to distinguish, and have called the whole phenomenon protective coloration, little guessing how wonderful a fact lay hidden under the name.

Mimicry makes an animal appear to be some other thing, whereas this newly discovered law makes him cease to appear to exist at all. The following are some examples of true mimicry. The screech owl, when startled, makes himself tall and slim, and with eyes shut to a narrow line simulates a dead stub of the tree on which he sits. Certain herons stretch their necks straight upward, and, with head and green beak pointed at the zenith, pass themselves off for blades of sedge grass. Certain harmless snakes spread their heads out flat, in imitation of their poisonous cousins, and rattle with their tails in the leaves. Many butterflies have stone or bark colored under sides to their wings, which make them look like a bit of bark or lichen when they sit still on a stone or tree trunk with wings shut over their backs. The newly discovered law may be stated thus: Animals are painted by nature, darkest on those parts which tend to be most lighted by the sky's light, and vice versa. The two effects cancel each other; the result is that their gradation of light and shade, by which opaque solid objects manifest themselves to the eye, is effaced at every point, the cancelation being as complete at one point as another, and the spectator seems to see right through the space really occupied by an opaque animal.

I leave to the reader the pleasure of discovering for himself that this principle of gradation in color is almost universal in the animal kingdom. In certain classes of birds and of flyi g insects, however, the principle gives place, more or less, to the device pointed out by Bates; namely, the employment of strong arbitrary patterns of color which tend to conceal the wearer by destroying his apparent continuity of surface. This makes, for instance, the mallard's dark green head tend to detach itself from his body and to join the dark green of the shady sedge; or the ruby of the humming bird to desert him and to appear to belong to the glistening flower which he is searching. Yet many other cases of color applied apparently at random conform essentially to the law stated above. The dark patches are on top, the light ones beneath. The breast mark, so widely used by nature on birds, usually has the effect of putting out a conspicuous and shining rotundity of some bright or light color, as in the meadow lark and the flicker: because it comes just where the breast, in its usual position, rounds upward and faces the sky. The dark collars of the males of most species of duck are absolute counter shading to the light from the sky, when the birds sit in their characteristic positions. For most female ducks nature uses the complete gradation, like that of grouse and sandpipers. Ground birds in general, such as grouse, sandpipers and sparrows, are usually clothed throughout in colors graded according to this principle. But the males of many species of pheasant are notable exceptions to this last statement.

Now there is still one more very beautiful phenomenon to record. If the animal itself is obliterated by

* Abbott H. Thayer, in the Auk, New York, April. Condensed for Public Opinion.

this mechanism of nature, for what useful purpose beyond considerations of sexual selections do his markings exist, since they are not obliterated? The answer is that the markings on the animal become a picture of such background as one might see if the animal were transparent. They help the animal to coalesce, in appearance, with the background which is visible when the observer looks past him. In many birds, for instance, those colors which would be seen by an enemy looking down upon them are laid on by nature in coarser and more blotchy patterns than are the colors on their sides, so that when you look down on them you see that their backs match the mottled ground about them; whereas, when you assume a lower point of view nearer their level, and see more and more of their sides, you find them painted to match the more intricate designs of the vegetation which is a little farther off, and which, from this new standpoint of the observer, now forms the background. In this latter position, the head of the animal, being the highest part of its body, is seen against the most distant part of the background, whose details are still more reduced by perspective. To correspond with this reduction of strength in the more distant background, the details on the sides of the animal's head are likewise reduced in their emphasis, and, like the more distant details, are smaller in pattern.

It is a most significant fact that throughout the animal kingdom the highest development of the arrangement of color and light described in this article, and the highest development of the habit of standing or crouching motionless in full daylight to avoid discovery, seem to coincide very closely. For instance, gallinaceous birds, most waders, and the cat tribe have both the color arrangement and the standing or the crouching habit highly developed. Contrasted with these, for example, are the skunks and the bears. Neither of these quadrupeds has the gradation of color nor the standing or crouching habit. They are both nocturnal, and therefore do not need either gradation or crouching for concealment. It is plain, then, that while nature undeniably completes the concealment of animals by pitching their whole color gradation in a key to match their environment, the real magic lies in the gradation itself from darkest above to lightest below, wherever this gradation is found. This is why it is so hard to see the partridge in the tree, the sandpiper on the mud, or the tiger crouching in the jungle.

RECENT DEEP SEA DREDGINGS.

During the months of June, July and August, 1895, the Prince of Monaco made a fourth scientific expedition to the Azores, in his ship Princesse Alice. The staff consisted of Mr. Jules Richard, in charge of the laboratory work; Mr. Lallier, zoologist; and Mr. Borrel, artist.

The expedition started from Monaco on May 23 and brought up at Havre on August 16. The scientific work, properly so called, was done between June 17 and August 12, upon an itinerary comprised between 37° and 49° north latitude and 11° and 31° west longitude.

Oceanography.—There were made 35 soundings, to a depth of 5,240 meters; 20 observations of the temperature of the bottom at a depth of 2,198 meters; 14 collections of specimens of water, coming from immediate contact with the surface of the submarine soil, at a depth of 5,240 meters, and designed for analysis.

Zoology.—Fourteen dredgings were made between depths of 550 and 4,443 meters, and most of them in the neighborhood of 1,500 meters; 14 immersions of bow nets, between 88 and 2,178 meters; 8 draggings of the mop bar, between 550 and 1,021 meters; daily captures by the harpoon, the gig or the drag line.

A new apparatus, that of Buchet, designed for pelagic fishing during the sailing of a vessel, and up to a speed of 7 knots an hour, was used and found to operate successfully; but it could not be employed to any extent, for the singular reason that for almost the entire course of the voyage the sea was covered every night with a bank of medusas (Pelagia noctiluca) so thick that the apparatus was quickly incumbered with these animals and the net threatened to break under their weight.

The soundings were made by means of a 2·3 mm. steel cable.

The most fruitful dredgings were the following: Three between 4,000 and 4,443 meters, which yielded many remarkable stellerides (Dytaster, Hymenaster, etc.) and some holothurians belonging to the genera Benthodytes and Psychropotes. The specimens of this latter were of an intense violet and were 0·46 m. in length. Then there were taken some anatifes, scolpellums and cirrhipedes, some pagurians and two brachyures, of the genus Ethusa, and, finally, some fishes, among which may be mentioned those of the genera Neostoma, Bathypterois and Macrurus, and, particularly, among the latter, a specimen 0·8 m. in length.

The dredgings at 2,000 meters yielded beautiful specimens of stephanotrochus, specimens of Caryophyllia communis, fragments of Crinoids and Brisinga and Ankyroderma and other holothurians, etc.

The dredgings at 1,000 and 1,500 meters furnished an abundance of animals of all groups, especially a fish that Prof. Collett refers provisionally to the genus Chimæra, and a dozen bodies elongated in the form of a carrot, and of a pale, reddish violet. The histological structure shows that these are the detached tentacles of an actinia remarkable for its size.

The use of the bow net confirmed the results previously made known. One of them, after remaining twenty-five hours upon a 1,385 meter bottom, brought up 328 fish, 16 synaphobranchus, 5 geryons, 4 red shrimps, and 2 cephalopods.

The principal animals obtained by means of the harpoon and gig and by the usual fishing apparatus, etc., were 1 spermaceti whale, 4 dolphins, 15 carcheries, 7 polyprion, 1 coryphæna, 17 germons, 7 turtles, and many small organisms that were floating upon the surface.

The capture of the whale furnished the capital event of this expedition. Its capture, in fact, was a dangerous moment for the ship, and the vomiting caused by its death throes yielded several large and complete cephalopods, one of which is probably a new species of the genus Histioteuthis; and another, covered with soft, polygonal, easily detachable scales, constitutes a new genus that Mr. Joubin calls Lepidoteuthis.

Upon the whole, this expedition of the Princesse Alice was the most fruitful for zoology that her owner ever made in her.—La Nature.

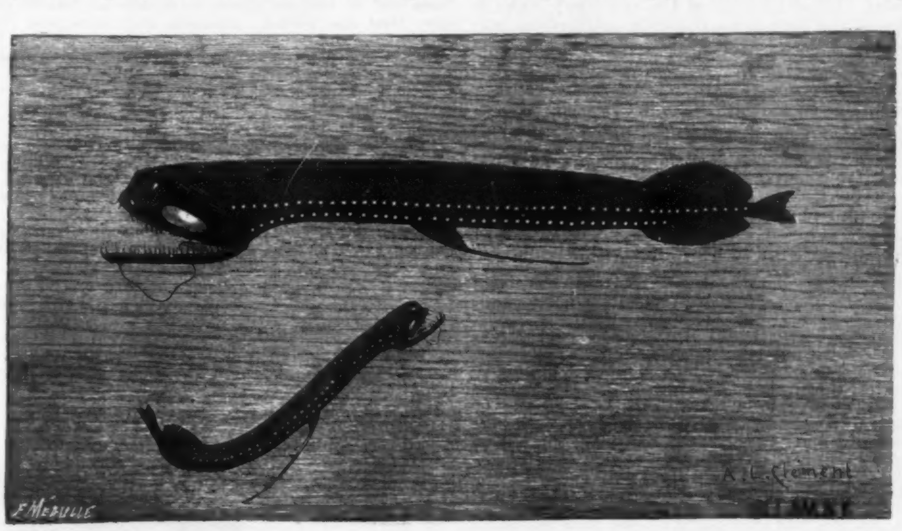


Fig. 2.—FISH (PHOTOSTOMIAS GUERNEI) CAPTURED BY THE PRINCE OF MONACO'S EXPEDITION.

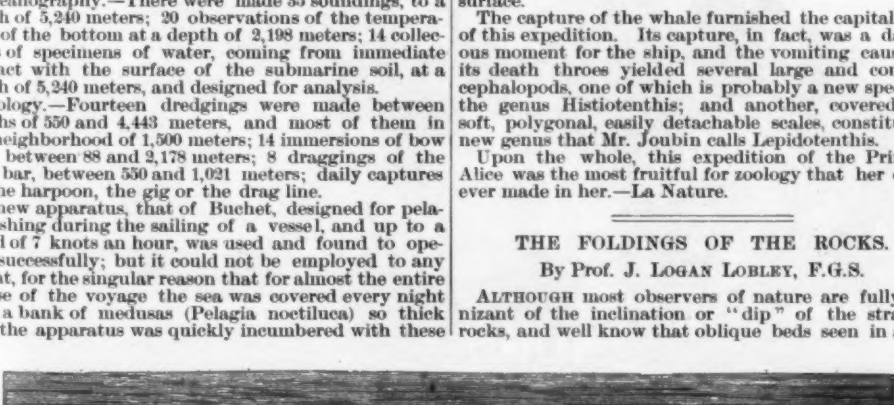


Fig. 1.—FISH (CHAMYDOSELACHUS ANGUMENS) CAPTURED AT A GREAT DEPTH IN THE SEA BY THE PRINCE OF MONACO'S EXPEDITION.

THE FOLDINGS OF THE ROCKS.

By Prof. J. Logan Lobley, F.G.S.

Although most observers of nature are fully cognizant of the inclination or "dip" of the stratified rocks, and well know that oblique beds seen in an exposure or section of these rocks are but parts of great folds, yet few are aware of the extent to which the sedimentary rocks have been disturbed from their original horizontality. It may even be said that few geologists, to whom rock foldings are familiar, realize the aggregate magnitude, much less the momentous significance, of the plications of the stratified rocks. It may, therefore, be useful to present a few facts to bring home to the mind the vast extent to which the once horizontally deposited strata, forming the exterior rind of the globe, have been folded and plicated since they were completed sheets of rock.

Cultivated, verdure-covered, or wooded land so generally forms the surface and conceals the underlying beds from observation in almost all generally known regions, that exposures of the rocks beneath the surface have to be sought for; but yet they are sufficiently numerous to reveal the general structure of the ground beneath us. Natural sections are seen in mountain precipices, torrent ravines, banks of rivers, and cliffs of the sea coast; while mining, quarrying, well sinking and boring, and road and railway engineering, with its excavations and tunneling, supply many and most valuable artificial sections.

Although these exposures of the rocks forming the exterior crust of the earth show in many cases horizontal or only slightly inclined strata, yet so many present to view highly inclined beds, and these in so many widely separated parts of the world, that, in the words of Sir Archibald Geikie, "we may readily perceive that the normal structure of the visible part of the earth's crust is one of innumerable foldings of rocks." The examples that follow must, therefore, be regarded merely as typical illustrations, and not by any means an exhaustive list of those that have been observed.

Our own country of England affords many remarkable examples of highly inclined and folded rocks. In Shropshire the Cambrian rocks of the Longmynd Hills are actually vertical, with beds of conglomerate in which the longer axes of the pebbles are upright; and so it is evident that these massive beds are but remnants of enormous folds, the upper parts of which—the crowns of the arches as it were—have been entirely removed. Such is also the case in the Isle of Wight, where, at both the east and the west ends of the island, the stratification of the chalk may be seen by the lines of flints to be almost vertical. In other places the rocks, through not so nearly vertical as in the above named localities, are yet very highly inclined. In the Vallis Valley, near Frome, in Somersetshire, the carboniferous limestone is at a very high angle—about seventy degrees—but overlaid by Jurassic rocks that are almost horizontal. The grand section of the carboniferous limestone in the gorge of the Avon below Bristol shows a dip of forty degrees throughout the whole section, which is fully a mile in length, giving the thickness of the formation. In the Mendip Hills the compression of the horizontal extension of the rocks by folding has been estimated to be as much as half of its original length. In many localities, too, the rocks are so plicated that they can only be called contorted, the bendings being so numerous in a small space and the angles so acute. Such are the Purbecks of Lulworth, in Dorsetshire, and the Lias of some sections in the midlands. The remarkable Silurian inlier in the midst of the Dudley coal field, forming the Wren's Nest, is but the summit of a fold of Wenlock limestone that rises through the coal measures. Of large but less acute foldings there is an example to the west of the Malvern Hills, where the Wenlock limestone is in a great synclinal that passes under the Ludlow, which at Ledbury becomes an anticlinal; and in the same county of Hereford the remarkable "valley of elevation" at Woolhope gives a conspicuous anticlinal of Upper Silurian rocks. A very fine example of folding, showing both the synclinal and anticlinal fold on a large scale, is presented by the London basin and the great valley of the Weald to the south, London being over a synclinal of the chalk which rises to the south and forms the North Downs that overlook the great Weald Vale, through which passes from east to west an anticlinal axis from which the beds dip to the north and south. In Wales the examples of inclined and folded rocks are almost as numerous as the sections, both North and South Wales being formed for the most part by greatly folded Palæozoic rocks. A remnant of a vast synclinal fold of caradoc rocks forms the upper part of Snowdon, in North Wales, and a great anticlinal of Ludlow rocks gives the Alt Fawr and Corw-y-Fan of Brecon, in South Wales; while marvelously contorted rocks, most acutely bent, may be seen at Holyhead Island, opposite the South Stack. Rock foldings and acute plications are as conspicuously displayed in Scotland and Ireland. Indeed, in some parts of Scotland there is seen an actual inversion of strata, the beds being bent back on themselves. On the coast of Berwickshire the Silurian rocks are highly contorted, and so also are the rocks near the Old Head of Kinsale, in Ireland.

When the English Channel is crossed the rock foldings are found to be on a still greater scale in surface extension than is indicated by the observation of Brit-

ish rocks alone. Along the whole distance, from Westphalia on the east to Somersetshire on the west, and even further, to South Wales, the Palæozoic rocks are folded in a succession of synclinals and anticlinals; and in the Ardennes, forming part of this line, enormous masses of these folded rocks have been removed by denudation, yet hills approaching mountains in elevation are left which are the remnants of the original vast plications. In the Eifel district of Germany the Devonian rocks are greatly plicated, and of the same age are the rocks forming a great anticlinal in the department of the Sarthe, in France; while Silurian rocks show foldings on an extensive scale in Bohemia.

Those who have traveled by the railway from Macon to Geneva may remember the rock foldings displayed by the cuttings along the base of the Jura range of mountains. These foldings of the secondary rocks in the Jura are, or have been, regularly alternating synclinals and anticlinals, though now showing much denudation, which in many cases has transformed the synclinal folds into elevations and the anticlinals into depressions. But when the Alps themselves are reached, rock folding is on a truly stupendous scale. Even to the ordinary tourist, the precipitous side of the Rigi toward Lake Lucerne shows, by the inclined beds there conspicuously displayed, the enormous uptilting and folding to which the Alpine rocks have been subjected; and at the southern end of the same lake, near Fluelen, highly plicated rocks will arrest his attention. It is, however, by the perforation of the main axis of the Alps by the great tunnel of the St. Gothard that we have become acquainted with rock folding in perhaps its greatest manifestation. Thus it has been found that the rocks forming the central portions of this great mountain range are mainly the vertical portions of vast plications, and at Andermatt and Airolo these rocks rise in a fan-shaped manner which gives actual inversions of strata. This enormous folding is found to be the prevailing character of the Alpine rocks from the northern side of Switzerland to the plains of Lombardy. The summit of the Great Ruchen, ten thousand feet above sea level, affords another example of a former vast fold having left as its witness a remnant of vertical beds; and on both sides of the great mass of Mont Blanc, in the Val de Chamouni and the Val Ferret, are vertical Jurassic rocks, which are but the remains of a fold that has extended over the rocks forming the summit of the monarch of the Alps. A grand example of inversion of strata is seen in the Glarnish Alp, where the beds are folded, as has been said, even as we might fold carpets. In the extreme north of Europe, too, both in Norway and the Ural Mountains, the Palæozoic rocks are found to be folded on a most extensive scale, giving in some places quite vertical strata, though overlaid by horizontal beds of recent geological age.

As in Europe so in Asia, the mountainous regions exhibit flexures on a grand scale, with Palæozoic rocks that are but the remnants of vast folds, in some of which, as in Baltistan, in the Himalayan region, the plications have been sufficiently extreme to quite reverse the original sequence of the beds. Far to the south of the Himalayas, too, in Mysore, the rocks have been greatly folded, and so far denuded as to leave but remnants of their original plications. In Asia, however, not only are the Palæozoic and the Secondary rocks folded on a great scale, but Tertiary strata are so too. The Eocene rocks of Afghanistan and Beluchistan give the broken and denuded anticlinal valley of Chumarlong, and the anticlinals at Tungar and the Deka Ridge. Again, to the east, the great folds of the Tertiary rocks form anticlinals on both sides of the River Jhelum, with synclinals so elevated as to give peaks and ridges forming lofty mountains, as the Murree Ridge; while Mount Mianjani, on the west of the great vale of Kashmeer, nearly ten thousand feet, is also formed by folded Tertiary rocks. The great Eocene limestone, called the Nummulitic limestone, is in great flexures in the northwest of India, which rise in the Balket Mountains to six thousand feet above sea level; and in the Sievalik Hills the still newer sandstones are greatly folded.

Though the mountainous regions of Africa have not yet been sufficiently explored to afford geological details, and many of the highlands are volcanic, we have abundant evidence of great folding of the rocks in that continent also, both in the north and the south. As was shown in Knowledge, page 51 of the present volume, the auriferous rocks of the Transvaal Witwatersrand are highly inclined, and are but remaining portions of great folds. In the north of Africa, and forming a large part of the main range of the Great Atlas, are gray shales having a nearly vertical position. Of these rocks Mr. George Maw says they are pre-Cretaceous, and "their almost vertical position appears connected with one of the several upheavals that have affected the chain." Metamorphic rocks, having a dip of from fifty degrees to eighty degrees, form hills in the immediate neighborhood of the city of Morocco.

The great western continent of America tells the same tale of enormous rock foldings. Although in North America there are great areas formed of rocks but little folded, yet in Canada, near the eastern coast, Palæozoic rocks, conformably overlying the Laurentian, have been much folded and even contorted; and in the neighborhood of Lake Superior there is a natural arch of rocks formed by an anticlinal, the interior rocks having been removed by water erosion. In Colorado both the Palæozoic and the Secondary rocks are so upheaved as to be almost vertical, being parts of great folds, and in the Mosquito range there are reversed folds. In Texas there are synclinal troughs, the bases of once enormous folds, and in New Mexico the carboniferous rocks are quite vertical, and in places even folded on themselves.

The rocks of the more eastern parts of the United States are also greatly folded. Indeed, so enormous has the plication been in the Appalachian Mountains, that Prof. Claypole estimates the compression of the original horizontal extension of the Appalachian rocks by subsequent folding to have been from one hundred and fifty-three miles to a present breadth of sixty-five miles. In Virginia and South Carolina the rocks are greatly folded, and in Massachusetts and Vermont the same phenomenon is conspicuous, vertical strata being displayed in the former of these two States.

In South America there is a magnificent display of folded and uptilted rocks, the Silurians, nearly vertical, rising to about twenty-five thousand feet above sea level at the summit of the Andes; and the Devonians and Carboniferous rocks forming great folds or parts of folds, chiefly synclinals, at lower levels, the latter giving to the west of Lake Titicaca a wonderful series of upturned edges. The Peruvians and Secondaries of the Andes exhibit similar phenomena.

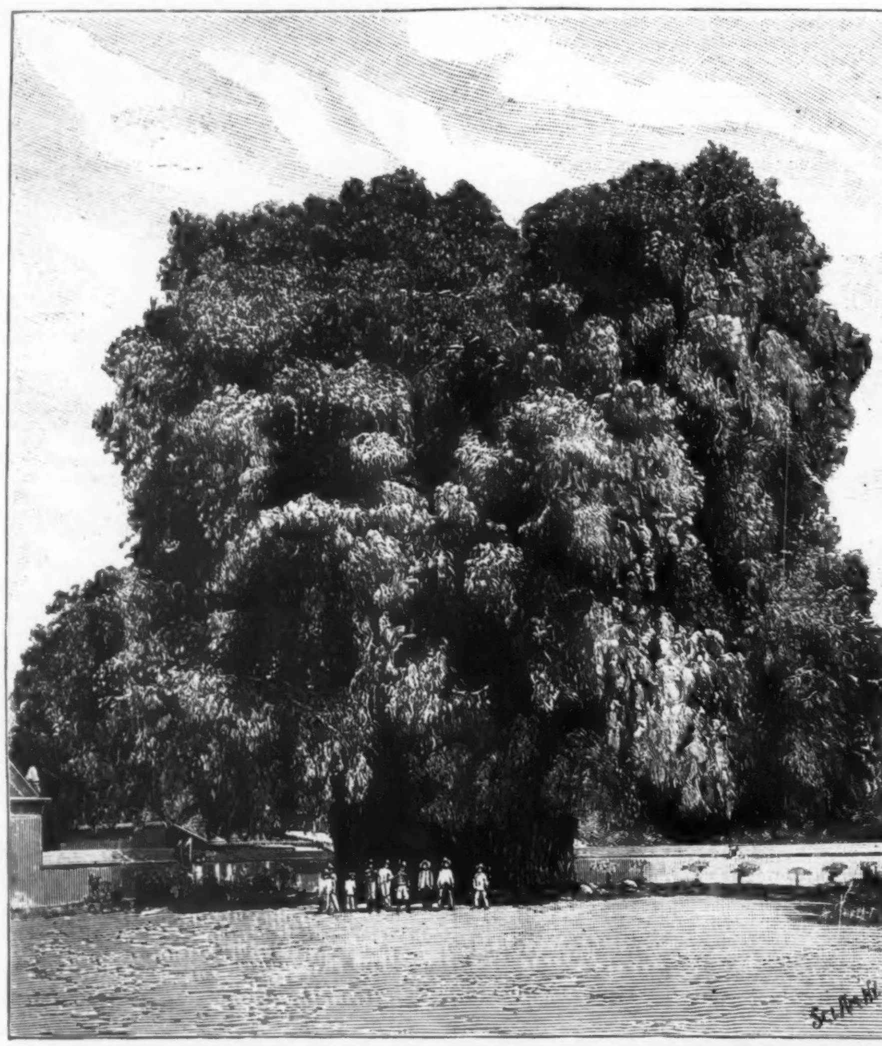
Nor is rock folding on a great scale wanting in the Australasian continent. In the Ballarat district of Victoria the Lower Silurian rocks have been so greatly folded that the strata are often nearly vertical; while in Gipps Land, in the same colony, the Devonian rocks are highly inclined, and in the Cape Otway district there is an enormous anticlinal fold of Mesozoic rocks.

Many other remarkable illustrations of rock folding might be given; but those now cited will suffice to conclusively show that the rocks forming the outer rind of the earth's lithosphere have been subjected at various times and at various places to enormous lateral pressure, that has folded, plicated, and crumpled them previous to the production of the present surface features. The discussion of the cause of this pressure must be left for a future occasion.—Knowledge.

GIGANTIC TREES.

THE ombu, a solitary inhabitant of the pampas, is one of the largest trees known. Its roots, which almost always run along the surface of the ground, are very long, and sometimes extend to a distance of 150 or 200 yards.

The accompanying figure is reproduced from a photograph taken in 1884 at the old military hospital of Buenos Ayres. A glance at it will give a very correct idea of this colossal and extraordinary tree.



THE OMBU, A GIGANTIC TREE OF THE ARGENTINE REPUBLIC.

In the trunk of the specimen here figured a cavity five yards in width has been formed, in which are placed three beds, which are used when the heat is oppressive.—La Nature.

THE USE OF OXALIC ACID IN PRESERVING THE COLOR OF DRIED PLANTS.

By J. HENRY SCHROEDER.

THE importance of a well selected herbarium is known to every botanist of the present day. It presents to him the most important specimens of the flora so far as known, and the better the specimens are preserved, the more valuable the collection. A very important, if not the most important, question is, how to preserve the natural color of the foliage, as well as the color of the petals.

No doubt, the rapidity with which the plant is dried greatly influences the preservation of the natural color; but in the course of time the great majority will fade, while others acquire different shades, some turn black, some brown and various other colors. This last change of color frequently takes place while the plant is being dried, and more rarely later on.

Not only the leaves, but the petals of most flowers change in the same way, thus lowering the value of the specimen to a considerable extent.

Nienhaus published in the Schweizerische Wochenschrift fur Chemie und Pharmacie* his experience with oxalic acid as a preserving agent of the color of petals of dried plants. His theory was that ammonia in the air caused the fading of the color, and that it would be neutralized by this acid; therefore, he recommended that the plant be dried between filter paper, which had previously been saturated in a 1 per cent. solution of the chemical, and then dried. Nienhaus experimented with the petals of Papaver Rhœas, and was very successful. According to some American writers, who have repeated his experiments, the results were entirely negative.†

Since then I have had occasion to study the value of Nienhaus' process, and have found that not only the petals are well preserved, but that a 3 per cent. solution will also preserve the color of the leaves. In the hope that the results may be of interest to collectors of plants, I think it proper to bring it to their notice.

Several specimens, which had been dried by the aid of 1 per cent. oxalic acid, did not give me as good results as I had hoped to obtain, and I then determined to study the value of different strengths of the solution, and find out which would be most suitable to be employed in average cases.

For this purpose I saturated some gray felt paper with a solution of oxalic acid, varying in strengths from 1 to 5 per cent., and dried.

Leaves of different texture were selected, dried between the thus prepared paper at ordinary temperature, changing paper once in twenty-four hours.

Leaves of a thin texture were well preserved with a 2 per cent. solution; not so well with that of 1 per cent. Those dried between 3 to 5 per cent. paper did not differ materially in appearance from those dried with that of 2 per cent. strength.

Leaves of a thick texture were best preserved with 3 per cent. of the acid, although the 4 and 5 per cent. solutions showed no disadvantage.

The leaves of aquatic plants were best preserved with 2 or 3 per cent. of acid; the 1 per cent. specimens turned dark, and with 4 or 5 per cent. they were almost black in one case, while in other aquatics I could observe no difference between any of the specimens; they all had kept well.

These results suggested to me that paper saturated with a 3 per cent. solution of oxalic acid might be used with more advantage for the majority of plants than a 1 per cent. solution, as recommended by Nienhaus. It is not unlikely that the kind of drying paper used influences the results to some extent.

Nienhaus recommended filter paper to be employed: in fact, the heavy felt paper mostly employed in this country is not often used in Germany for drying purposes; the botanists there prefer a very much thinner gray paper.

In almost all cases where a 3 per cent. solution of oxalic acid was employed, I have obtained satisfactory and encouraging results, except with some members of the Umbelliferæ, which turned dark when thus treated.

* Monat-blatt des deutschen Apotheker Vereins von New York, March, 1895 (B. I. H).

† Bulletin of Pharmacy, June, 1895, p. 269.

I had not the opportunity of making further experiments with them, and do not know their behavior when dried in paper without the aid of oxalic acid.

The leaves of Phytolacca decandra, under ordinary circumstances, turned to a very dark color; when dried by the aid of a 3 per cent. solution of oxalic acid, they remain green.

The leaves of Geranium maculatum commonly turn reddish brown; when preserved with 3 per cent. of the acid, they remain green.

The leaves and petals of Baptisia tinctoria almost invariably turn black when dried in the ordinary way; when preserved with 3 per cent. oxalic acid, the change is much less pronounced and the petals remain yellow.

In all specimens the color of the petals was unchanged.

The results which I have obtained by this process lead me to the conclusion that it may be employed with decided advantage in almost all cases, and I will briefly state the method I have employed:

Heavy gray felt paper was thoroughly saturated with a 3 per cent. solution of oxalic acid, and dried. This, when done at ordinary summer temperature, required about twelve hours. Directly between the thus prepared paper I placed the plant; in case the petals were very delicate, they were protected by a very thin piece of paper to prevent imprints from the rough felt paper. The latter was changed once in twenty-four or thirty-six hours, until the plant was thoroughly dried, and it was then mounted in the ordinary way. If possible, the plants should be placed in the press at the time of collection, or carried in an airtight box and moistened before pressing.

Up to the present date I have not had the opportunity of studying by experiments to what extent plant colors are really injured by ammonia, but I hope to be able to report upon this question at a subsequent date. —American Journal of Pharmacy.

BETEL CHEWING.*

By Dr. RODNEY H. TRUE.

AMONG the many means to which mankind turns for relief from the monotony and the drudgery of existence, few furnish solace to so many at so little expense to the mind and to the body as the chewing of the betel nut. If evidence were needed to show that it satisfies to a great degree some strong desire felt by a large part of the human race, the fact that betel chewing is a habit with about one-seventh of the population of the globe would be sufficiently convincing. That such a habit can have a history of over twenty centuries on one continent, and that this is at present the most populous part of the earth, vouches for the absence of seriously harmful results. It enters largely into the ancient customs of the East and plays an important role in the lives of millions from early childhood to old age. It makes demands calling forth extensive industries and creates a considerable commerce. It gives hints to the physician and offers to science some of its most attractive fields for research.

The betel chewing habit covers a wide geographical range. Beginning with the eastern boundary of Afghanistan on the west and the Himalaya Mountains on the north, it rules all to the east and the south including the islands of the Pacific as far as Torres Straits (north of Australia) and as far east as 169° east from Greenwich, including, therefore, a great part of the scattered groups of the Northern Pacific. Within these limits, with but a few local exceptions, the natives of all races, colors and conditions, male and female, kings, princes, priests and paupers, daily and hourly, at work or at ease, standing or sitting, at home or with strangers, almost "from the cradle to the grave"—all are slaves to this habit.

Although causing no pronounced mental manifestations, exerting in general only a mild effect, this habit holds its devotees with a relentlessness almost without

FIG. 2.—SILVER INSTRUMENTS USED IN BETEL CHEWING. JAVANESE WORK.

(From Tschirch: Indische Heil- und Nutzpflanzen.)

a parallel. The last test to which the Tagali maiden puts her lover to prove the ardor and the sincerity of his attachment is to require him to abstain from the betel. He may comply, but it is only temporary, since he is sure to return sooner or later to the old ways. On the island of Timor, when a chieftain dies, betel chewing is not indulged in for the seven days following. In India, after the death of a kinsman, deep sorrow is expressed by leaving this luxury untouched.

For the preparation of the betel roll as chewed, three very different articles are necessary: the nut of the betel palm, Areca Catechu L. (Fig. 1), the leaf of the betel pepper, Piper betle L., and powdered lime, usually obtained from calcined mollusk shells. The pungent pepper leaf is daubed over with a little lime, a piece of the betel nut laid on it, the whole rolled up and thrust into the mouth. It is chewed until the mass is exhausted of its juices, when the remainder is discarded and a new "chew" immediately prepared. It would be interesting to know what circumstances many centuries ago led some native experimenter to bring together these three so widely differing ingredients.

As before hinted, betel chewing has a long history, so

FIG. 1.—BETEL PALM.

(From Lewin's work l. c.)

long, indeed, that a host of customs and traditions have grown up about it.

One of the earliest records of betel chewing dates from 161 B. C., when, in a battle between the people of the Malabar region and those of another race, the Duttagamini, the Malabar warriors discovered on the lips of their enemies the blood red color given by betel chewing and spread the rumor that their foes were wounded.

In the tenth century, Masudi, the Arabian writer, described betel chewing as a national habit in India. At later dates, numerous historians and travelers have described the habit in detail and have left us pictures which in all essentials represent the conditions now prevailing among the masses of the inhabitants of the betel chewing world.

As the cola nut in Africa and the kavakava root among the islanders of the Pacific, so within its realm the betel furnishes the basis for many ceremonial usages. The betel, wherever used, is the sign of friendship, peace, courtesy and hospitality. At a mere meeting on the street or at the formal reception of ambassadors, on entering a hut or a palace, the betel is offered and gladly accepted. The failure to extend or to accept this courtesy is regarded as a great neglect or an insult. Under these conditions, friendly relations cannot exist.

Marriages could hardly take place without this friendship-founding and friendship-sustaining article. In Siamese, the word for home is kan-mak, meaning a dish containing betel. A betel roll prepared with spices and sent by a woman to a man is regarded in parts of India as a declaration of love.

At divorce ceremonies, the betel pepper figures conspicuously. The wife arraigns the husband before the authorities, pays a fixed sum, and is free after she tears a betel leaf into two parts, one of which each of the principals consumes.

In parts of New Guinea, the daughters of the chiefs, when they become twelve or thirteen years old, remain at home for two or three years, after which their return to society is celebrated with much pomp. In the dance which takes place, the debutantes pass in and out among the dancers and make known their selection of a lover by handing him a betel nut.

In many places it is regarded as improper for a person of lower rank in speaking with a superior to cease chewing his betel roll. This probably is due to the fact that the betel sweetens the breath when chewed, and to cease might expose the person of higher degree to annoyance from the other's evil breath.

Although the symbol of friendship and good will, the tender of the betel may conceal deadly designs, since poison is easily administered by this method. Perhaps for this reason, it is customary in Sumatra to accept betel nut and pepper leaf, but to use lime from one's own pouch. Danger is regarded as especially apt to lurk in the delicacies offered by the women.

On the Brahmaputra River, the natives measure distance by the number of betel rolls consumed in marching it. It is, of course, a time unit rather than one of distance. A similar custom is found among the coca chewers of Peru.

In religious ceremonies, the betel plays an important part. The ingredients, especially betel nuts, are frequently found as offerings laid on the altars for the gods. In Borneo, at the burial of the dead, Hatton saw the corpse in full dress, in a sitting posture, a cigarette in the mouth and near at hand a receptacle containing all of the ingredients necessary to betel chewing.

In New Guinea, the people believe that the future life is to be spent absolutely without work and care in the possession of endless quantities of betel nut, and day and night are to pass in the enjoyments of eating, dancing and chewing the betel. A fuller account of these and of many points of interest necessarily omitted here may be found in Dr. L. Lewin's admirable monograph entitled "Ueber Areca Catechu, Chavica betle und das Betelkauen."* This paper has been freely used in the preparation of this article.

Before passing on to the consideration of the action of the betel, we will notice more particularly the method of preparation of the roll and the instruments used.

Although in the essentials the method is with all races the same, many local variations are, however, found. The condition of the betel nut when consumed is not always the same. Sometimes the hard, dry, mature nut is chewed after it has been cut in pieces or powdered; again, the younger, soft nuts are chosen.

In Siam, instead of wrapping all three constituents together, a portion of the nut is put into the mouth and a piece of the pepper leaf covered with lime taken afterward. In the Philippine Islands, a somewhat more artistic method is found. The leaf after being covered with the lime is so folded as to form a flat band. The ends are then brought together, forming a ring into which is fitted a round slice of the nut. A peculiar custom is found among the Malayans of Java and Borneo. The tip of the pepper leaf is always broken off and discarded before use. The reason for this procedure lies in an old legend. As a certain king almost at the point of death tossed on his couch in despair, a snake approached him bearing in his mouth a leaf of the betel pepper, tendering with the leaf the advice to try its efficacy. The king took the leaf, tore off the tip which the snake had held in its mouth and, after eating the leaf, enjoyed a quick recovery. In memory of this incident, the tip of the leaf is torn off even at the present day.

The betel nut is contained in a tough, fibrous husk from which it must be freed. To aid in this, as well to reduce the dry nut to a proper state of division, instruments are necessary. For removing the husk, a somewhat sickle shaped knife is used in India. The hard nuts are either broken by a blow from some heavy object or split by means of some edged tool. Rude wooden mortars with pestles made from the shell of some gigantic ocean mollusk are used by natives of some regions. Since the nuts yield more readily to an edged instrument, strong knives of various patterns or heavy shears are used. The knife used in India for this purpose usually has a strong handle and a broad, bent blade.

In the pharmacognostical collection of the University of Wisconsin are a number of instruments, exhibited at the World's Fair, from Johore. Among the tools for husking the nuts are found three different forms. One has a short, broad, double-edged, bent blade. Others are not sharpened, being merely narrowed to a thick, strong point. The third form is sharpened much after the manner of an ordinary chisel.

A brass instrument used for dividing the nut consists essentially of a cylinder having at the upper end an inside diameter of 18 mm. Gradually contracted downward until near the lower opening, it is suddenly narrowed to a diameter of 13 mm. by a collar-like projection into the tube. The accompanying piece, likewise of brass but rather roughly filed into form, is chisel like and plays into the tube as far as the sudden contraction near the lower end. Pieces of nut are dropped into the tube and chopped until the fragments fall out at the lower opening.

For cutting the nuts a kind of shears is employed in some regions. They consist of two arms, the lower of which merely supports the nut, the sharp upper blade dividing it. These shears are to be found from the simplest design to the most richly ornamented. In Fig. 2 are elaborate examples from Java, made of silver.

The betel chewer needs, of course, some sort of a receptacle for the various ingredients used. These receptacles are of the most various forms and workmanship. Some are woven from plant fibers, some are formed from gourds or cocoanut shells. The permanent and ornamental receptacles are made of wood, sometimes most richly decorated with copper, silver or gold, with carving or with inlaid work of variously colored woods or mother-of-pearl. In Sumatra, the outfits of the wealthy are usually of silver, enriched with beaten work. In Java, a receptacle with compartments for the lime, betel nuts, tobacco and cardamoms is customary. These boxes are likewise ornamented in all degrees of richness. In Fig. 3 is represented a compartment receptacle of a simpler sort from Johore.* It consists of two parts, the box proper and a shallow till with places for the various ingredients. Special care must be taken with the lime supply. If more is desired than is demanded for immediate consumption, it must be kept in airtight receptacles in order that it may not lose its caustic property, and therewith its efficiency. Various devices for this purpose are made use of. All

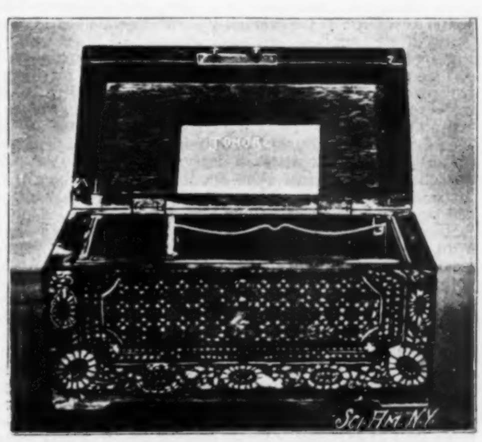


FIG. 3.—SIMPLE COMPARTMENT RECEPTACLE.

variations are found from the joints of bamboo tightly stoppered, used by the common people, to the richly carved ebony and tortoise shell articles of the rich.

Since each time a new betel roll is taken into the mouth the saliva is at first ejected, cuspidors may fairly enough be included in the list of necessities. As would be expected, this problem is easily solved by the poor. The higher classes have receptacles for this purpose made in various ornamental forms. In the royal court

* From the Pharmaceutical Review.

* Ferdinand Enke, Stuttgart, 1889.

* This illustration is taken from a specimen in the pharmacognostical collection of the School of Pharmacy, Madison, Wis. It was exhibited at the World's Fair, from Johore.

of Siam, a servant carries a golden spittoon about after the king. In Java the princes have in their train two pages or young girls, one of whom carries about the copper cuspidor, the other the golden betel box.

How does the betel habit affect its devotees? The effect following the first experiment with the betel as experienced by one not habituated is an unpleasant, burning sensation in the mouth and a feeling of constriction in the throat. As the chewing is repeated, however, the first disagreeable effects wear off, giving place to sensations so agreeable that even Europeans become devotees of the habit.

The quantity of saliva secreted is much increased and a blood red color is imparted to it. In the Pharmacographia Indica, it is stated that the natives freely eject this red spittle, "preferably over recently whitewashed walls. The dry stains are often mistaken by the police for blood stains, and pieces of plaster, leaves and grass thus stained have frequently been forwarded to the chemical examiner for detection of blood."

The dark red color given to the gums and lips as well as the blackening of the teeth are among the most conspicuous results of betel chewing. White teeth are regarded by the Malayans as an imitation of apes and dogs, while the brownish black teeth of the betel chewer are much celebrated in Indian song. The agreeable perfume given to the breath is stated by the betel user to be one of the many reasons for his indulgence.

The physiological action depends on several factors. If one is unaccustomed to the practice or if green nuts are used, a temporary dizziness may follow. A poisonous variety of betel nut is occasionally found, but this is regarded by the authors of the Pharmacographia Indica to be a form that has reverted to its former wild condition. In general, the betel is a mild, narcotic stimulant bringing about a feeling of general comfort, good humor and exhilaration. These effects, however, are not more marked than those experienced by the user of tobacco while enjoying his "Havana."

From the standpoint of toxicology, less is to be said against the betel habit than against either the tobacco or the alcohol habit. Lewin sums up the matter in these terms: "Those who take into consideration the conditions prevailing in the land of the betel chewer come to the conclusion that, in view of the peculiar nature of the scanty nutrition of the Indians and the many climatic influences threatening the health, a moderate indulgence in betel chewing is advantageous."

The prophylactic and healthful influence of betel chewing has been recognized by the Dutch government by making provision for the distribution of the ingredients in hospitals and prisons. Whether the protection against fevers claimed by some for the betel habit is a reality or not must be here left undetermined.

Probably the greatest evil lies in the slavery to which this habit condemns its devotees and in the consequent danger of moral degeneration.

To all who take pleasure in a wonderful symmetry and perfection of form, the palm furnishing the betel nut is said to offer great delight. A straight, smooth, slender shaft of a dark green or grayish green color, it stands, supporting at its summit six or eight long, shining, feathery leaves. Although attaining a height of from fifty to a hundred feet, its trunk is a column having a diameter of less than a foot even at its base. So graceful is its entire aspect that the Indian poets say it is an arrow shot down upon the earth from heaven. Others compare it to the form of a beautiful woman and praise it as being not merely the most beautiful of trees, but also as the benefactor of him who cultivates it.

Seen either as a single object of rare grace of outline (Fig. 1), or in groves fringing some oriental jungle, this palm seems to justify the claim made for it by its poet friends.

Where its first home was is difficult to determine, since it has for untold centuries been cultivated in so many parts of the tropical world. It is still found growing wild in the Philippine Islands, and is probably to be regarded as a native of tropical Asia, India or eastward, or of some of the adjacent islands. It now has practically the same geographical distribution as the betel chewing habit.

Although it thrives in ordinary soils, the culture of the betel palm necessitates a long period of patient work before results begin to appear. The seeds first ripened are chosen for planting. After the winter solstice, they are removed from the trees, thrown into heaps and kept in houses for several days prior to being planted. The soil chosen for the seed bed must be well dug over to a depth of from one to two feet, the rich surface soil is removed and manure or other fertilizers are spread over the surface. The nuts are laid close together upon this layer, with the so-called "eyes" turned upward, and are then covered with the rich soil before removed. Buried thus beneath an inch or so of earth, the seeds are watered daily for three months. At the end of this time, the seedlings reach a height of three or four inches and must be transplanted into a bed prepared in the manner just described.

Here at a distance of about a foot and a half from each other they grow for about three years, receiving water every day during that time. The young palms are next transplanted to larger quarters in carefully prepared soil at a distance of about twenty-five feet from each other. Among them are planted musa, cocoa and orange trees and perhaps around all a thick hedge of Euphorbium or Jatropha Curcas. One more transplanting after another three years brings the trees finally into their permanent quarters, where with frequent digging over and fertilizing of the soil and monthly irrigation, they come to bearing at an age of from six to ten years. From twenty-five to thirty years is the usual time during which the areca palm is expected to continue fruitful.

The leaves are about fifteen feet long with opposite pinnæ. Some are slightly ascending, forming the feathery crown, others of somewhat different form are somewhat inclined to be pendent. Each of the narrowly-lanceolate, pointed pinnæ is about a yard long. The sheathing base of the leaf is broad, and during the rainy season protects the inflorescence which develops in the axis of the leaf. The areca leaves fall during our winter months. So important to the natives is this tree that the Malays in places date the beginning of the new year from the time of the fall of the betel palm leaves.

The areca palm blooms throughout the entire year and may have at the same time flowers and fruit in various stages of growth. The flower clusters develop in the axils of the leaves, coming, however, to the blooming stage only after the fall of the leaves. Thus, the flowers and fruits come to be situated on the stem a little below the leafy crown. The somewhat broom-shaped flower clusters, inclosed in the smooth, oval-lanceolate spathe, consist of unisexual flowers, the male being more numerous and situated along the distal parts of the axis, the fewer female flowers toward their bases. The flowers themselves are inconspicuous in appearance. At the time of flowering, a pleasant fragrance emanates from the pistillate flowers.

The time necessary to bring the fruit to maturity is about six months, but after three months of growth the young nuts are sometimes used. The fruits develop inside of the spathe until finally the pressure generated splits it and the clusters of egg-sized nuts are to be seen in the shade of the thick leaves hanging from a thick axis. The mature nuts are surrounded by a fibrous, husk-like covering which has a thickness of about one-fourth of an inch. The nuts themselves on being freed from the coverings are of various shapes and sizes according to the variety. In general, they preserve the egg-like form of the whole fruit. The outer surface of the free nut is marked more or less distinctly with a mesh-like pattern. The attachment of the seed is at its broad end. The average weight of a betel nut is from five to seven grammes, its specific gravity about 1·25.

When seen in section, the nut is made up of two sharply contrasting tissues, the white, horny albumen and reddish streaks which wind in an irregular manner from the circumference nearly or quite to the center. These reddish lines mark the infoldings of the seed coverings. The albumen is composed of sclerenchyma cells with strongly marked pits, the reddish lines of smaller, thin-walled parenchyma cells filled with a reddish brown substance.

The nuts when ripe do not fall from the trees, but are picked by a particular class of people who make this their business and hire out to the raisers during the harvest seasons. The fruitfulness of this palm is shown by the fact that an average tree in India yields six hundred nuts, as many as a thousand being sometimes taken from a tree.

Lewin, on whose authority a great part of that here given rests, found as a result of his chemical investigations of the areca nut a snow white, crystalline fat present in an amount varying from fourteen to eighteen per cent. When fresh, this fat is tasteless with a light, pleasant odor reminding one of cacao. It was found to consist mainly of lauric, myristic and palmitic acids. The most active principle present appears to be the alkaloid arecoline. In doses of from ten to twenty milligrammes, it proved fatal to cats. It slows the heart's action and affects respiration. In fatal doses, respiration ceases before the heart's action is stopped. Poisoning with arecoline is accompanied by a strong contraction of the pupil. Arecaine and its isomer arecaidine, choline and guvacine, all of them bases, have also been isolated from the areca nut.

Although cultivated widely and over the general area characterized by the betel habit, still within this area a considerable commerce in betel nuts exists. The chief points of export are Ceylon, the Straits Settlements and Sumatra. The chief importing countries are India, despite the enormous home production, and China.

The leaf of the betel pepper, Piper betle L., is a necessary constituent of the betel roll. This plant, as its name indicates, is a near relative of a number of well known things; the pepper, the cubeb and the kava-kava, now attracting some attention in medicine, are all members of this genus and, in their habits and appearance, more or less closely resemble it.

The betel pepper is a perennial, creeping vine which by means of long tendril-like structures fastens itself upon whatever support it chances to find. The flowers are diœcious, the stamens and pistils being found in separate flowers. The root is much branched, the stem, round and woody, of about the size of a person's finger, is smooth, much branched and of a jointed structure. At the nodes many small, clinging roots are given off which serve to fasten the vine to its support. The internodes are from three to five inches long. The broadly heart-shaped or sometimes more nearly rounded leaves have entire margins and are more or less acuminately pointed. They are mostly membranaceous, rarely somewhat leathery, smooth on both sides, marked by translucent, punctate dots. The upper surface is shining, the lower pale green. In size the leaves are from three to seven inches long and from two to four wide. The flowers, as is usual in this family, are in catkinlike aggregations.

The plant lives from twenty to thirty years, but gives the best product during the first six or seven years. It prefers a moist, rich, clay soil in shady places.

The betel pepper, like the betel palm, has been under cultivation for unknown centuries, and the accounts given five hundred years ago concerning the method show that time has brought about no essential change. Division of labor in East India has resulted in a class of people whose exclusive occupation is the cultivation of the betel pepper, and still another class fulfills the function of middleman by getting the crops marketed.

Growing the betel vine demands the greatest care and industry, and many risks have to be run, since the plants are liable to injury from many causes. Besides guarding from insect pests, too much exposure to the sun and injury from strong winds threaten the crop. If, however, the work is rewarded by a good crop of leaves, the profits are great.

In Mysore, in July and August, ditches half a yard wide, of like depth and about forty feet long, are dug at a distance of about five feet from each other. The land between the ditches is made into beds in which are planted at first quickly growing plants to serve later as supports for the betel vines. Every second day the bed is sprinkled and the ditches filled. After four months, the cuttings of the pepper are set in the beds in two rows. These cuttings are about two feet long and stand from three to five feet apart in the row. The garden is then surrounded by a hedge of Euphorbium Tirucalli. The trenches must be kept filled and the beds frequently watered. After about three months the pepper vine begins to cling to its supports when the weeds are cleaned out and the soil about the plant manured. This careful attention is finally rewarded after nearly two years with leaves fit for use.

The leaves for market are picked by hand from the branches which hang free from the support, those from parts attached to the tree or pole on which the vine climbs being regarded as unfit for use. The largest as well as the smallest leaves are discarded. Since the leaves decrease in size after the plant reaches a certain age, those from old plants are undesirable. The leaves are best when used fresh, and an acceptable method of preservation for more than a few days does not seem to be in use.

Lewin, Eijkmann and others who have studied the betel leaf from the chemical standpoint, found as constituents a small quantity of a volatile oil, a resin-like body and traces of an alkaloid. The volatile oil has a light brown color, an agreeable tea-like odor and contains, according to Power's catalogue, betel phenol, or para eugenol and cadinene. According to Schmidt, this oil is located in the mesophyl cells of the leaf in close connection with the chlorophyl, and not, as would be expected, in the glands of the leaf.

The physiological action of the betel leaf is not very pronounced. When fresh, the leaves have a very strong, peculiarly aromatic odor, those growing exposed to the sunlight being sharper in taste than those grown in the shade. No plain symptoms follow the use of the leaves and Lewin regards it as doubtful whether more than the taste imparted to the betel roll is contributed by this constituent. Experiments on animals with powdered leaves gave negative results. The oil, however, showed itself more active. It has an anæsthetic action locally like that seen in its congener, the kava-kava plant. In subcutaneous injections, it acts as a narcotic preceded by a stage of over-excitation.

Schimmel & Company report it as useful therapeutically in the treatment of inflammation of the mucous membranes of the larynx and the throat.

The third usual constituent of the betel roll is lime. This is of organic origin, corals and the shells of large sea mollusks being burnt and powdered.

The part played by the lime in betel chewing is an important one. In answer to the question, why it is essential, Lewin states it as probable that the lime releases the alkaloids present in combination with tannin and other substances, and enables them to produce their characteristic results. He also regards the presence of lime as necessary to the formation of the fragrant volatile principle in the betel nut which gives to the breath of the betel chewer its pleasant scent. The part played by the betel leaf beyond the slight anæsthetic action on the tongue and mouth and the aromatic qualities of the oil seems to be unimportant.

PAST AND PRESENT TENDENCIES IN ENGINEERING EDUCATION.*

By MANSFIELD MERRIMAN, Professor of Civil Engineering in Lehigh University; President of the Society for Promotion of Engineering Education.

THE present status of engineering education in the United States is the result of a rapid evolution which has occurred in consequence of changes of opinion as to the aims and methods of education in general. These changes of opinion, whether on the part of the public or on the part of educators, together with the resulting practice, may be called tendencies. All progress that has occurred is due to the pressure of such views or tendencies; hence a brief retrospect of the past and contemplation of the present may be of assistance in helping us to decide upon the most advantageous plans for the future.

Thirty years ago public opinion looked with distrust upon technical education. Its scientific basis and utilitarian aims were regarded as on a far lower plane than the well-tried methods of that venerable classical education whose purpose was to discipline and polish the mind. What wonderful changes of opinion have resulted, how the engineering education has increased and flourished, how it has influenced the old methods, and how it has gained a high place in public estimation, are well known to all. The formation of this society in 1893, its remarkable growth, and the profitable discussions contained in the three volumes of its transactions, show clearly that technical education constitutes one of the important mental and material lines of progress of the nineteenth century.

Engineering courses of study a quarter of a century ago were scientific rather than technical. It was recognized that the principles and facts of science were likely to be useful in the everyday work of life and particularly in the design and construction of machinery and structures. Hence, mathematics was taught more thoroughly and with greater regard to practical applications, chemistry and physics were exemplified by laboratory work, drawing was introduced, and surveying was taught by actual field practice. Although engineering practice was rarely discussed in those early schools, and although questions of economic construction were but seldom brought to the attention of students, yet the scientific spirit that prevailed was most praiseworthy and its influence has been far reaching.

This scientific education notably differed from the old classical education in two important respects: first, the principles of science were regarded as principles of truth whose study was ennobling because it attempted to solve the mystery of the universe; and, second, the laws of the forces of nature were recognized as important to be understood in order to advance the prosperity and happiness of man. The former point of view led to the introduction of experimental work, it being recognized that the truth of Nature's laws could be verified by experience alone; the latter point of view led to the application of these laws in industrial and technical experimentation. Gradually the latter tendency became far stronger than the former, and thus the scientific school developed into the engineering college.

The very great value of laboratory experiments, and of all the so-called practical work of the engineering school of to-day, is granted by all. Principles and laws which otherwise may be but indistinct mental propositions are by experimentation rendered realities of nature. The student thus discovers and sees the laws of mechanics, and is inspired with the true scientific spirit of investigation. It should not, however, be forgotten that if such practical work be carried beyond the extent necessary to illustrate principles, it may become a source of danger. The student of aver-

* Presidential address before the Society for the Promotion of Engineering Education at the meeting in Buffalo, N. Y., August 20, 1896.

age ability may pass a pleasant hour in using apparatus to perform experiments which have been carefully laid out for him, and yet gain therefrom little mental advantage. Especially is this true when the work assumes the form of manual training, which, however useful in itself, is properly considered by many as of too little value to occupy a place in the curriculum of an engineering college.

The tendency toward the multiplication of engineering courses of study has been a strong one, especially on the part of the public. This has resulted in a specialization that, as a rule, has not been of the highest advantage to students. In some institutions this has gone so far that the student of civil engineering learns nothing of boilers and machines, while the student of mechanical engineering learns nothing of surveying or bridges. The graduate is thus too often apt to lack that broad foundation upon which alone he can hope to build a successful career.

The development of the scientific school into the engineering college has been characterized throughout by one element of the happiest nature, that of hard work and thoroughness of study. The numerous topics to be covered in a limited time, their close interrelation, and the utilitarian point of view, have required many hours per week and earnest work by each student in preparation for each exercise. The discipline of hard and thorough work is one whose influence can be scarcely overestimated as a training for the duties of life, and in every university it is found that the activity and earnestness of the engineering students is a source of constant stimulus to those of other departments. Thus scientific and engineering education has tended to elevate the standard and improve the methods of all educational work.

The length of the course of study in engineering colleges has generally been four years, and whatever tendencies have existed toward a five years' course have now for the most part disappeared. With higher requirements for admission, particularly in English and in modern languages, a reduction of the length of the course to three years may possibly be ventured in the future, particularly if the long summer vacation be utilized for some of the practical work, as indeed is now the case in several institutions.

There has been and now is a strong tendency toward a reduction in the length of the college year. While formerly forty or forty-two weeks were regarded as essential, the process has gone on until now some colleges have but thirty or thirty-two weeks, a reduction of nearly twenty-five per cent. having been effected in twenty-five years. Undoubtedly the long vacation is utilized to great advantage by the majority of students in actual work, yet the fact remains that it is not good business economy to allow the buildings and plant of a college to lie idle for so large a part of the year. It is perhaps possible that in the future the summer schools may be so developed that the work will be practically continuous throughout the year, thus giving to students the option of completing the course either in three or four years.

The report of the committee on requirements for admission, which will be presented later in the session, sets forth many facts which show the tendencies now existing. Almost without exception a higher standard is demanded, both that students may enter with better mental training and that more time may be available in the course for technical subjects. While the general line of advance is toward an increase in mathematics and in modern languages, there is also found, particularly in the central States, a demand for broader training in science. It has already been pointed out that our early engineering schools were strong in scientific training, and that the tendency has been to replace this by industrial applications. If the requirements for admission can be extended to include the elements of chemistry and physics, with some botany or zoology, the engineering student will enter with broader views, a keener power of observation, and a scientific spirit, that will greatly increase his chances for success in technical studies.

The general increase in requirements for admission tends to raise the average age of the student. It is now usually the case, owing to the greater length of time needed in preparatory work, that the average age of the classical student is one year higher than that of the engineering student; or the former has had one more year of training than the latter. One more year of training means much as an element for success; one more year in age means an increase in judgment which is of the highest importance for a proper appreciation of the work of the course. The older men in a class usually do the best if not the most brilliant work, and after graduation their progress is the most satisfactory. It thus appears that all tendencies that raise the age of entrance are most important ones and deserve hearty encouragement.

Having now considered some of the general elements and tendencies in engineering education, it will be well to take up the programme of studies, especially in regard to those subjects that are common to all technical courses. The three volumes of the transactions of this society contain many carefully prepared papers and interesting discussions which enter into questions of detail concerning nearly all topics in the curriculum. Here, however, can only be noted briefly the main lines of development and the indications for future progress.

Mathematics is undoubtedly the most important subject in all courses of engineering study, and it has been demanded for years that it be taught with great thoroughness. This demand has been met more completely in the independent engineering colleges than in the engineering courses of the universities. Much, however, remains to be done in this direction, and probably it cannot be satisfactorily accomplished until a change in method has been effected. The fundamental element in the change of method must be, it seems to me, in a partial abolition of the formal logic of the text books and an introduction of historical and utilitarian ideas. Mathematics is a tool to be studied for its uses, rather than for its logic or for the discipline that it can give; hence let its applications be indicated frequently and not be systematically kept out of view. If the student gains the impression that his mathematical exercises are merely intended to train the mind, his interest and his progress will usually be slow. If, however, he learns what mathematics has done in the past, how it joins with mechanics to explain the motions of the distant planets as well as to advance the material prosperity of man, there arises an interest and a zeal that helps him to overcome all difficulties.

The great advantage of numerical exercises in all branches of pure and applied mathematics and the deplorable lack of good preparation in arithmetic have been expressed by many educators. In numerical computations the average engineering student is weak, in spite of the numerous exercises in his practical work. To remedy this defect, better instruction in arithmetic is demanded in the common and high schools, while in engineering colleges the teachers of mathematics should constantly introduce numerical work and insist that it be done with a precision corresponding with the accuracy of the data.

Next to importance in mathematics comes mechanics, the science that teaches the laws of force and motion. In most institutions the rational is separated from the applied mechanics and often taught by the mathematical department. Probably less improvement has resulted in the teaching of rational mechanics during the past quarter of a century than in any other subject. That mechanics is an experimental science whose laws are founded on observation and experience is often forgotten, and the formal logic of the text books tends to give students the impression that it is a subsidiary branch of mathematics. The most interesting history of the development of the science is rarely brought to the attention of classes, and altogether it appears that the present methods and results are capable of great improvement.

It should not be overlooked, however, that in recent years the so-called absolute system of units has been introduced into mechanics, and is now generally taught in connection with physics. Here the pound or the kilogramme is the unit of mass, while the unit of force is the poundal or the dyne. Although this system possesses nothing that is truly absolute, it has certain theoretical advantages that have commended its use, notwithstanding that no practical way of measuring poundals has been devised except by the action of the force of gravity on the pound. Engineers have continued to employ the pound weight as the unit of force, and the calculations of the physicist must be translated into the units of the engineer before they can be understood. The student of rational mechanics thus has the difficulty at the very outset of two systems of units, and great care should be taken that each be thoroughly understood and the relations between them be clearly appreciated by application to many numerical problems. In view of these and other difficulties, and of the novelty of the subject in general, it appears that some engineering colleges do not give to rational mechanics as much time as its importance demands.

Physics in some colleges is taught by a course of five or six exercises per week, extending over a year, while in others the elements are required for admission and the regular course is correspondingly abridged. The marvelous development of electrical theory and practice has naturally tended to make this the most important topic in the course, sometimes indeed to a material abridgment of mechanics, acoustics, thermodynamics and optics. Considering how great is the importance of each branch of physics and the advances that are made every year in new directions, it may also be concluded that more time can be profitably given both to the theory and to experimental work. Physics is a fundamental subject whose principles and results are of constant application in every walk of life, and a student who thoroughly covers a well arranged course has gained a mental discipline and a scientific habit of mind that will be of greater value than the technical details of a purely engineering specialty.

Undoubtedly the most powerful tendency in engineering education has been in the direction of the development of those special technic subjects which may be grouped under the name of construction and design. In civil engineering this has led to plans for railroad, water supply, and bridge construction; in mechanical engineering to engine and machine design, in mining engineering to projects for mine plants, and in electrical engineering to the design of dynamos and motors. These courses have been demanded by the public and by the students themselves, and have been often elaborated to an extent beyond the best judgment of teachers of engineering. To the extension of such courses there is no limit, but it is a question whether the process has not already gone too far. For instance, it would not be difficult to arrange a course of twenty or thirty exercises on water pipes in which should be discussed all the methods of manufacture and processes of laying cast iron, wrought iron, lap-welded, steel-riveted, and wooden mains, together with a comparison of their relative economies under different conditions in different parts of the country. These lectures, however, would plainly be of such a technical nature that the advantage to the student would be slight. They would give valuable information, but little training.

In all courses in construction and design the practical limit seems to be reached when the exercises are of such a nature as to give mere information and little scientific training. The aim of all education, and of engineering education in particular, should be to render the student conscious of his mental power and sure of applying it with scientific accuracy so as to secure economy of construction. Fundamental principles are hence more important than the details of a trade, and all exercises in design should be arranged so that the student may think for himself rather than blindly copy the best practice of the best engineers.

The subject of applied mechanics, which occupies an intermediate place between rational mechanics and the work in design, has been so differentiated that the mechanics of materials is now almost the only topic common to all engineering courses. The strongest line of development has here been in the introduction of testing machines and in the making of commercial tests. This work is of high value, although it may be doubted if the use of one or two large testing machines is as advantageous as that of many smaller ones which are designed especially to illustrate principles. The student of the present day enjoys, however, advantages that were unknown a quarter of a century ago, and the marked progress in applied mechanics from both the scientific and technical point of view is a source of congratulation.

English and modern languages are generally called culture subjects, and it is well known that, of all the topics in the engineering course, these are the ones in which students have the least interest. The great importance to an engineer of being able to clearly and correctly write his own language can scarcely be overestimated. Further, it may be said that no engineer can hope to attain eminence unless he can read German and French literature. These opinions have long been held, and, furthermore, it has been recognized that engineering students and graduates are often lacking in that general culture which the world demands as one of the conditions of success. Great improvements have been made in the methods of teaching English and modern languages, and probably still greater ones are yet to result. In the ideal engineering colleges of the future perhaps these subjects will be required for admission, as is now done by at least one institution, but at present they must be generally taught. The main line of improvement to secure better results will be, it seems to me, in partially abandoning the idea of culture and placing the instruction upon a more utilitarian basis. If English be regarded as a means to an end instead of linguistic drill, if the aim of teaching French and German be to read fluently the language of to-day instead of laboriously to decipher the meaning of the poets of centuries ago, true zeal on the part of students will arise and a truer culture will result.

At the close of the college course the student presents a thesis showing his ability to apply the principles and rules of engineering in the investigation or design of a special problem. The tendency has been strong to abandon subjects which involve mere description or compilation, and to insist upon those that will require the student to exercise his own powers. Thus the value of the work to the student has been greatly increased, and the theses of each class are a source of stimulus to the following ones. Although the view held by some, that theses should be monographs setting forth important conclusions of original investigations, is one that cannot in general be realized, it is a gratification to note that each year a few theses are produced which are sufficiently valuable to warrant immediate publication.

The formation of engineering clubs among students for the discussion of the details of professional work is one of the most important tendencies of recent years. No exercise is so valuable to a student as one entirely originated and performed by himself, and the preparation of a paper which is to be presented to and criticised by his fellows ranks highest of all among such exercises. Recently there has been forced upon my notice a remarkable activity in the three engineering clubs of a certain engineering college, more than fifty papers having been read and discussed during the year by a total of about three hundred and fifty students, besides a number of others read before the mathematical club. In meetings of this kind the scientific and economic questions under discussion in the engineering journals receive a detailed attention which the professor in the class room often finds it impossible to give, while the advantage to students in expressing themselves in debate is very great.

Occasional lectures to classes by practicing engineers have been introduced in many institutions during the past decade, and with uniformly good results. In engineering education there is no conflict between theory and practice, and every professor cordially welcomes distinguished engineers to explain their great structures and achievements to his classes. It is an inspiration to students to see and hear those men who have so successfully applied sound science to economic construction, and whose influence has been uniformly to elevate the standard of the profession.

After four years of work the engineering student receives his degree and is ready to commence the actual work of life. What the letters are that designate the degree is a matter of small importance. Moreover, if we examine the lists of alumni who graduated ten or fifteen years ago, the conviction arises that their particular course of engineering study has not been an absolute factor in determining their actual line of engineering work. It is found that graduates in civil engineering are engaged in mining, in machinery and in electricity, and that graduates in other courses are employed upon work in which they received no especial technical instructions. Thus it appears also that the particular course of engineering study is not so important a matter as students and the public generally suppose. In fact, a young man thoroughly grounded in fundamental principles and well trained how to apply them, has almost an equal chance for success in all branches of engineering practice.

Looking now over the field of tendency thus briefly outlined, it is seen that there has been ever present a powerful impulse toward specialization, to which, indeed, nearly all others have been subordinated. This has demanded a higher standard of admission, great thoroughness in all fundamental subjects, and a rigid adherence to scientific methods. Engineering education has had an active and healthy growth, it now enjoys the respect and confidence of the public, and its future is sure to be more influential than its past. It is not specialization that has caused its success, but rather the methods which specialization has demanded. Those methods have resulted in imparting to students zeal and fidelity, a love of hard work, of veneration for the truths of science, and a consciousness of being able to attack and overcome difficulties. These elements of character are, indeed, the foundation of success in life.

Looking now forward into the future, it is seen that in our efforts for the promotion of engineering education a wide field for work still lies open. The student should enter the engineering college with a broader training and a more mature judgment. The present methods of instruction are to be rendered more thorough and more scientific. In particular, the fundamental subjects of mathamatics, physics and mechanics are to be given a wider scope, while the languages and the humanities are to be so taught as to furnish that broad, general culture needed by every educated man. In general, let it be kept in mind that education is more important than engineering, for the number of men who can follow the active practice of the profession will always be limited. Hence let it be the object of engineering education to influence the world in those elements of character that the true engineer possesses, so that every graduate may enter upon the duties of life with a spirit of zeal and integrity, with a firm reliance upon scientific laws and methods, and with a courage to do his work so as best to conduce to the highest welfare of his race and his country.

LAUTENSCHLAGER'S NEW REVOLVING STAGE.

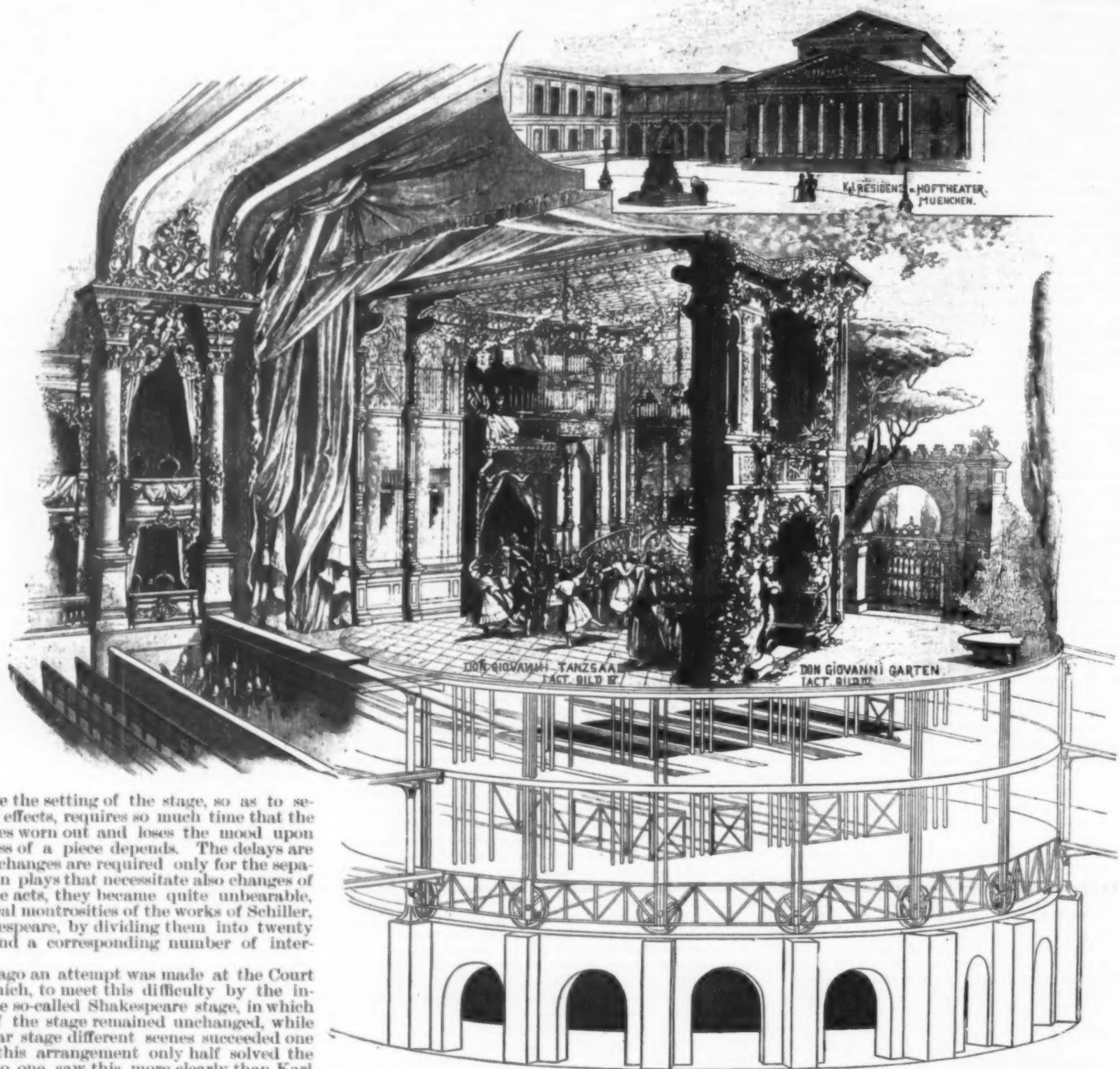
FOR some years past the public has been demanding more and more realistic presentations of plays, but the managers have found great difficulty in satisfying this demand, because the setting of the stage, so as to secure the desired effects, requires so much time that the audience becomes worn out and loses the mood upon which the success of a piece depends. The delays are tiresome, when changes are required only for the separate acts; but in plays that necessitate also changes of scene during the acts, they became quite unbearable, making theatrical montrosities of the works of Schiller, Goethe or Shakespeare, by dividing them into twenty or more acts and a corresponding number of inter-acts.

Several years ago an attempt was made at the Court Theater, in Munich, to meet this difficulty by the introduction of the so-called Shakespeare stage, in which the front part of the stage remained unchanged, while on the raised rear stage different scenes succeeded one another. But this arrangement only half solved the problem, and no one saw this more clearly than Karl Lautenschlager, the mechanical director of the Royal Theater of Bavaria, who was the real inventor, although it was credited to Baron Von Perfall, who was at that time general manager of the Munich Theater, and before many years he published a book setting forth his ideas in regard to a thorough transformation of the stage as it then existed. Possart, manager of the royal stage in Munich, made a practical and most successful test of Lautenschlager's invention in a representation of Mozart's "Don Juan," which was put on the stage during the latter part of last May. The revolving stage is no longer an uncertainty, but has proved itself to be the arrangement best adapted to supplant the present stage arrangements.

When the nature of Lautenschlager's invention first became known, many people associated it with the device used on Japanese stages, which consists of a revolving platform in the center of the stage, and bears only a superficial resemblance to Lautenschlager's arrangement. The latter resembles more closely a device employed in America and England for displaying living pictures, but even that could not be used for practical stage business.

The arrangement used in the Court Theater, at Munich, is essentially as follows:

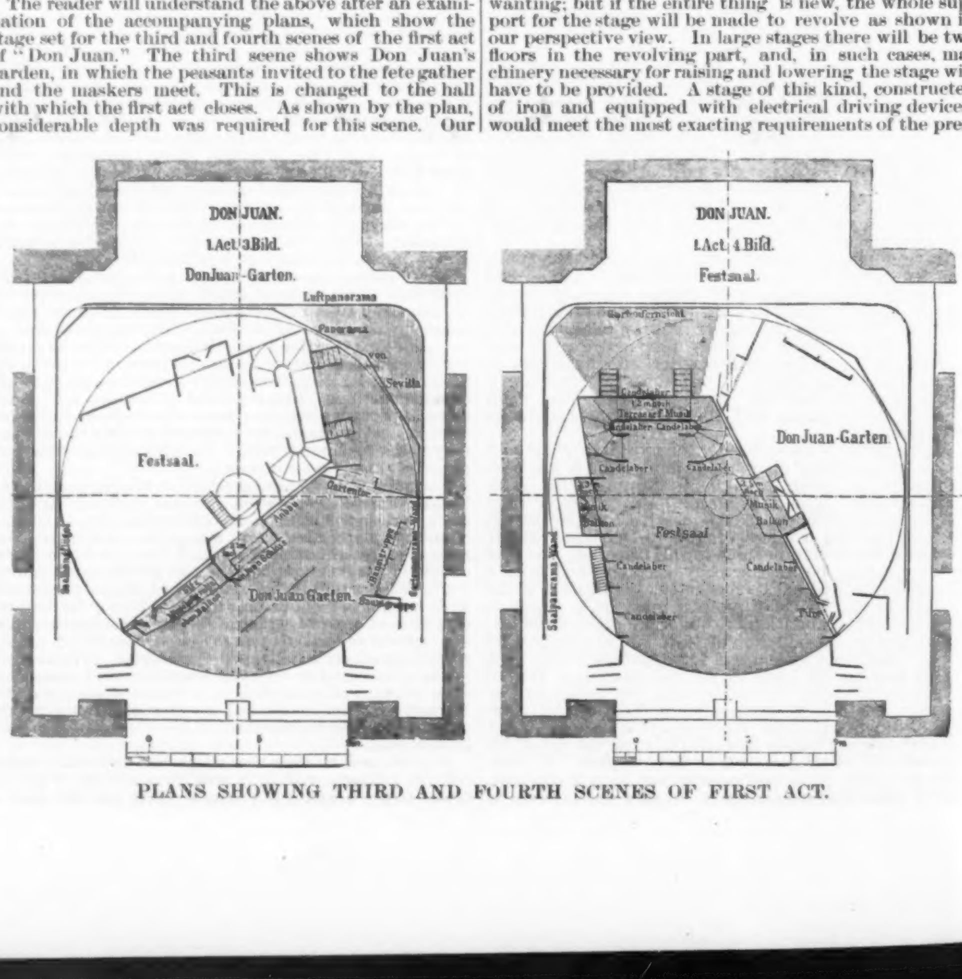
On the ordinary stage floor is placed a revolving disk or platform, which raises the floor slightly. This circular platform is 52 ft. 5 in. in diameter, and presents not quite a quarter of a circle to the proscenium opening, which is 32 ft. 9 in. wide. It turns on rollers that run on a circular track; the revolving mechanism is driven by electricity. If a scene is set on the quarter circle presented to the audience—perhaps a closed room of considerable depth—something similar can be arranged on the opposite side of the platform which opens to the rear of the stage, as well as on the other quarters, so that four different scenes are set on the stage at the same time. For a play of four acts, requiring a different setting for each act, all four scenes can be prepared beforehand, and at the end of the first act the stage is turned a quarter of a circle (which requires about ten or eleven seconds), and the scene desired for the next act is presented to the audience, and so on at the end of each act. In case three changes were required in one act, after the portion of the stage occupied by the first scene had been turned away from the audience, it would be cleared and set for the first scene of the next act. The scenes need not be limited to representations of closed rooms; any desired scene can be set on the turning stage, and, if necessary, the whole stage can be used the same as any ordinary stage. Difficulties will occur only when two scenes requiring great depth, for instance, two landscapes with distant views, follow one another. But Lautenschlager has shown that even these difficulties can be overcome by setting the scene along the radius of the circular stage so that the portion used decreases considerably toward the rear, and in this way he gains the entire depth of the stage for another scene. Much more of the artistic element enters into the setting of a stage of this kind than of a stage that is set on straight lines.



CHANGE FROM THE THIRD TO THE FOURTH SCENE OF THE FIRST ACT OF "DON JUAN."

The reader will understand the above after an examination of the accompanying plans, which show the stage set for the third and fourth scenes of the first act of "Don Juan." The third scene shows Don Juan's garden, in which the peasants invited to the fete gather and the maskers meet. This is changed to the hall with which the first act closes. As shown by the plan, considerable depth was required for this scene. Our large illustration shows how this change is accomplished, or how it would appear if darkness did not prevail when the stage was being turned. Before the garden had completely disappeared, a portion of the hall would be visible with all the life and motion, the dancers, and the gayly dressed crowd of guests.

If, as in the Munich Theater, the revolving stage is placed on an old stage, the special machinery will be wanting; but if the entire thing is new, the whole support for the stage will be made to revolve as shown in our perspective view. In large stages there will be two floors in the revolving part, and, in such cases, machinery necessary for raising and lowering the stage will have to be provided. A stage of this kind, constructed of iron and equipped with electrical driving devices, would meet the most exacting requirements of the pres-



PLANS SHOWING THIRD AND FOURTH SCENES OF FIRST ACT.

ent age. The success of Lautenschlager's plan in the Munich Theater gives ground for the hope that it will soon be adopted in other theaters.

The inventor of this stage, Karl Lautenschlager, was thoroughly educated as an engineer, and has had so much experience in the management of the mechanical devices of different theaters that he is admirably fitted to plan a thoroughly practical stage.—Uber Land und Meer.

DR. BOOTH'S MOTOR CAB IN COMPLETED FORM.

READERS of the Horseless Age are aware that Dr. Carlos C. Booth, a practicing physician of Youngstown,

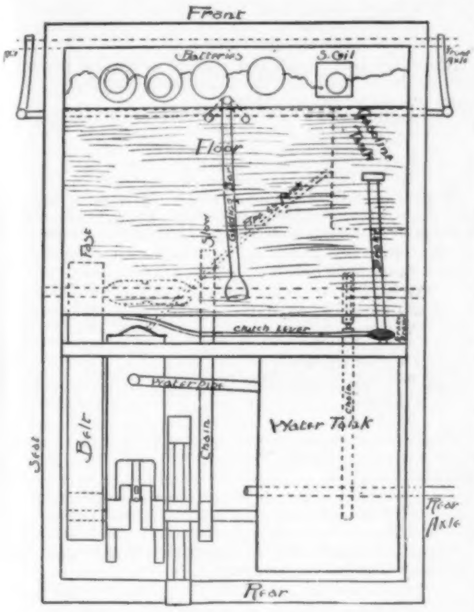


DIAGRAM OF THE BOOTH-CROUCH CARRIAGE.

O., has been engaged upon a motor wagon, or cab as he calls it, for over a year past. For several months he has been using this cab in making his professional rounds, having the distinction of being the first physician in the United States to use a motor vehicle in his practice.

This vehicle was entered in the Cosmopolitan race under rather discouraging circumstances, due to haste and imperfect experimental work, but the doctor now believes that he has conquered all difficulties, and has a satisfactory means of horseless locomotion.

In the course of his business the doctor states that he has made a speed of fully 16 miles an hour, climbed hills of 10 to 15 per cent. grade at five miles an hour, ridden through mud six inches deep at five miles an hour, and through mud two inches deep at 12 miles an hour.

The vehicle weighs 1,040 pounds, and the body is especially designed to hide the means employed to propel it. The motor, which was designed and built by W. Lee Crouch, of New Brighton, Pa., weighs 130 pounds, and is claimed to develop three horse power. The cylinder is 4 by 6 inches, the balance wheel 18 inches in diameter, and the speed is 500 revolutions per minute. So completely is the exhaust muffled that no disagreeable noise is heard. Power is transmitted at slow speed by a cut steel chain, made by the Boston Gear Works, running on sprocket wheels to fit. At high speed a 4 inch belt is used in connection with two Bleveney friction clutches, put on or off the high or low speed as desired. This chain and belt transmit to the countershaft, and from that power is transmitted to the rear axle by another chain and sprockets. On the rear axle is a compensating gear. The foot brake lever is connected with a drum brake on the countershaft.

For the foregoing description and the diagram we are indebted to the Horseless Age. The engraving of the carriage is from a photograph made by the SCIENTIFIC AMERICAN'S photographer on the day of the Cosmopolitan Race.

THE COSMOPOLITAN HORSELESS CARRIAGE RACE—THE BOOTH-CROUCH CARRIAGE.

THE ORIGIN OF PNEUMATIC TIRES.

IN an article in the Indiarubber World, Hawthorne Hill says: One can readily believe that the attention of visitors to the fashionable parks in London, at a certain period just half a century ago, was "much attracted" by the appearance among the gay equipages of a certain brougham, after reading the contemporary descriptions of the latter. The vehicle had been constructed without springs, but its chief novelty lay in certain "improvements" patented by a civil engineer of Middlesex County, named Robert William Thomson, in the shape of what he called "noiseless tires." They were, in fact, the pioneer pneumatic tires, and the inventor had boldly started out to exhibit them on the wheels of a brougham weighing nearly 1,200 pounds. The present time, marking, as it does, the semi-centennial of so many important applications of Indiarubber, seems a proper occasion for recalling Thomson's "patent aerial wheels," though it is not proposed to connect their invention, by any link, with the pneumatic tires which have become so successful.

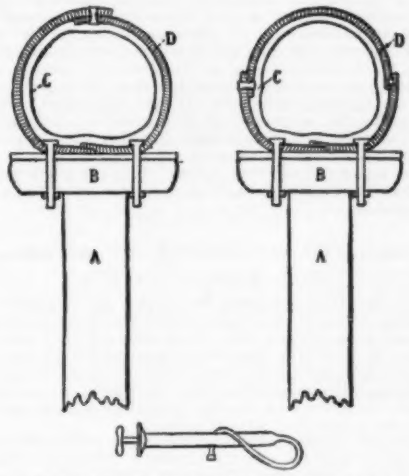
"The nature of my invention," says Thomson in his specification, No. 10,990, of 1845, "consists in the application of elastic bearings round the tires of wheels of carriages, rendering their motion easier, and diminishing the noise they make while in motion. I prefer employing for the purpose a hollow belt composed of some airtight or watertight material, such as caoutchouc or gutta percha, and inflating it with air, whereby the wheels will in every part of their revolution present a cushion of air to the ground, or rail, or track, on which they run."

This elastic belt, as Thomson called his inner tube, was composed of several thicknesses of canvas, each "saturated and covered on both sides with Indiarubber or gutta percha in a state of solution," laid one upon another, and each "cemented to the one immediately below it by a solution of Indiarubber or gutta percha, or other suitable cement."

How the edges were joined to complete the belt as a tube is not mentioned.

But it was the outer casing or cover that first caught the public eye, and to understand its construction one must refer to the drawings. A represents the end of a spoke; B is a section of the wooden felly, much broader than usual, and tired with steel; C is the inner tube, and D is the leather shoe. The latter is built upon the wheel by attaching two long strips of leather to the whole circumference, with bolts inserted through the felly and steel tire at every few inches. The outer edges of these strips were brought together over the inner tube and riveted together, after which the tire was complete.

Or a third strip of leather might be used, as shown in the drawing to the right, being riveted to one of the base pieces and laced to the other. A pipe through which to inflate the inner tube was passed at one place through the tire of the wheel, and fitted with an airtight screw cap. In the lower drawing is shown the "condenser" used for inflating the tube. It was the size of Thomson's tires, next to the noiselessness of the wheels, that most attracted attention. They were about 5 inches in diameter, intended to be so inflated as to keep the tire of the wheel $2\frac{1}{2}$ inches from the ground, which was thought to be sufficient to admit



THOMSON'S PNEUMATIC TIRES.

of the wheels passing over any stones or other matters projecting beyond the general level of any ordinary turnpike road without the solid tire coming in contact with them. Wagons for the carriage of goods were expected to need tubes of a larger diameter and stronger materials.

In commenting upon the new style of wheels, the Mechanics' Magazine (London), after the trial brougham had been drawn upward of 1,200 miles, without "the slightest symptoms of deterioration or decay" in the tires, had this to say: "It has so long been regarded as a settled thing that friction is least with hard substances and greatest with soft, that by a natural, though not perhaps strictly logical, course of induction we inferred that, though in this case the noise might be less, the friction, and consequently the tractive power required, would be greater. We must candidly own that

we little expected to find the very reverse of this to be the fact. Yet so it is." Then are given the results of experiments made with Thomson's wheels in the Regent's Park by a noted firm of coach builders, and verified by the editor, showing the comparative lightness of draught of the "aerial" wheels, both on a smooth and firm road and on a section covered with newly broken stone.

The table follows, showing draught in pounds.

	Common wheels.	Patent wheels.	Saving by pat. wheels per cent.
Over smooth, hard road.....	45	28	60
Over new broken flints	120	38½	301

Evidently our pioneer inventor had given much thought to his work, for in his specification he treated at length of the variations possible in the construction of the pneumatic tire, in order to make the patent as "broad" as possible. Some of it is good reading, too, as showing the ideas he entertained with regard to the properties of air in wheel tires.

One variation of Thomson's original suggestion of an inner tube was that several tubes might be employed for a single tire—up to nine, for instance. In such cases the ordinary air pipe would have to be dispensed with, the inflation being accomplished by means of air screws in one end of each tube before they were laced into the leathern envelope. It was suggested that the leather might be protected from wear by covering its outer surface with flat-headed metal rivets secured on the inside with small washers.

The latter end of the "aerial" wheel is not certainly known, but tradition has it that its inventor was much laughed at.

ELECTRO DEPOSITION OF NICKEL.

By J. Warren Hartley.

The surprising progress which the art of electro deposition of nickel has made since the introduction of electro plating, some fifty years ago, together with the difficulty arising in obtaining good results in this particular art, owing to the inferior conductibility of nickel as compared with silver and gold, prompts me to give those interested a few practical points, which I hope they may find advantageous.

As many works have heretofore been published treating upon the theoretical points, I will not dwell on them, but confine myself entirely to the practical side.

Care of the Dynamo.—As the dynamo is the most important piece of machinery employed in the nickel plating plant, let me say a few words in relation to care of this delicate machine. I have found that by paying strict attention to my dynamo, thereby keeping it in proper shape, I am enabled to accomplish much better results.

When the machine is working properly there is absolutely no grinding or flying of copper dust and not the slightest spark visible. The brushes should be set so as to touch the commutator in a horizontal line, and as there is one neutral or non-sparking position in commutator, the rocker should be set at same and never changed. This non-sparking point may be slightly below or above the horizontal line, but the proper position can be found by moving the rocker slightly forward or backward. The brushes and commutator should always be kept clean. I have found it advisable to clean commutator and brushes off each morning with piece of fine sandpaper. The use of paraffine on commutator I have found beneficial.

Nickel Solution.—The preparation of a nickel bath is a simple process known to every plater, and as it is cheaper and more practical to procure your nickel salts from a responsible firm engaged in the preparation of same, it is unnecessary to explain the methods of preparing the above, but for the benefit of the novice I may give a few instructions in preparing a nickel bath for immediate use.

First, I dissolve the crystals of double sulphate of nickel and ammonia (nickel salts) in a vessel or tank suitable, by pouring on hot water, stirring well with a piece of wood until the water becomes saturated, then place in plating bath. Fresh water is then added upon the undissolved crystals until entire quantity is dissolved and sufficient solution required. For a solution of sixty gallons I use forty-five pounds of nickel salts. The hydrometer when floated should stand seven for proper working strength; but I have found solutions testing eight or nine yielding satisfactory results. When the solution is complete I dip a strip of blue litmus paper into it, and if it turns red, I add a few ounces of ammonia, with brisk stirring. The solution is tested again, for it must be borne in mind that a nickel bath should be as nearly neutral as possible.

Another nickel solution which I have found to yield good results is as follows:

Nickel salts	¾ pound
Water.............................	1 gallon
Sal ammoniac......¾ pound to each 60 gallons	

I have frequently found that after working a nickel bath for a short time, especially in a warm atmosphere, green salts of nickel and ammonia began to crystallize upon the upper surface of the anodes and interior of tank. After noticing the original water line I find it necessary to add sufficient water to make up the solution to its original height, and to keep it up to its normal strength I find it advisable to add fresh crystals of double salts. In doing this, however, it will be best to ascertain the specific gravity and add only sufficient crystals to bring it up to the standard. I have also discovered that the continued addition of ammonia in the nickel bath not only prevents the formation of peroxide of nickel, but is the means by which the acid which is set free becomes neutralized; for when the anodes fail to supply the bath with the amount of nickel taken from it by the articles coated, the acid is liberated and an inferior deposit is the result. Therefore, it is important to keep the solution neutral constantly by the addition of ammonia.

Unlimited precaution should be exercised in the care of a nickel solution, that is, kept free from dust, and the sediment undisturbed which sometimes forms at the bottom, especially when impure anodes are used; for instance, anodes containing iron cause a yellow deposit to be formed which is exceedingly troublesome, since it not only attaches to the surface of the anodes, but also becomes deposited in a mass at the bottom of the bath, and the slightest disturbance of this sediment renders it absolutely necessary to let the bath repose until it is clear again.

I would advise operators to stir their solutions two or three times a week in the evening, thereby letting it repose over night, when it will be perfectly clear in the morning, and after skimming off the top, will be ready for use.

A very important and troublesome defect in the deposition of nickel I have often observed to present itself, and which must receive immediate attention; that of certain dark streaks starting from a given point and extending downward to the outer edge, especially on articles which have holes or rivets. The cause of the defect is dirt or grease beneath the head of rivet or lodged in the hole on said articles, which, when the article is in the solution, gradually oozes out, and by its gravity slowly traverses the face of the article while deposition is going on. At the spot where the particles of dirt have been slowly traveling there is little or no deposit of metal, and as these defects will show themselves at an early stage, the article should be immediately, upon observation of same, taken out and scoured again, rinsed and returned to the bath, for it would be fatal to the success of the operation if these precautions were not taken.

There has been prevailing among platers the mistaken idea that it is impractical to go beyond a certain point in depositing nickel, considering it has a tendency to crack and peel off if this limit is exceeded. I have found that, by a gradual and slow deposit, to be able to run nearly several hours without any danger of the above, especially in bicycle and stove work, which is left a dead or satin finish.

When it is found necessary to run a light batch or small articles, I have found it advisable to employ what is termed a stop, to prevent them from burning—that of suspending a piece of stout copper wire from either end of the negative rod.

Mr. Desmur, in Watt's, of 1889, recommends the introduction of chloride of sodium (common salt) in nickel solutions, which will give a much whiter deposit and augments the conductivity by 30 per cent., the diminution of resistance being in proportion to the quantity of chloride of sodium added; for the conducting power of a solution of nickel salts, he states, increases with its degree of concentration up to the point of saturation. I have used the above satisfactorily, but would advise those engaged in this art not to try any experiments with their solutions. By exercising the proper precaution in the care of your solution, together with regular stirring and continual addition of ammonia, a solution of nickel salts will, I find, yield satisfactory results. If the solution should deposit darker color, the addition of a little boracic acid and a few pounds of single salts is all that is necessary to bring it up to a whiter deposit. Yet, those desiring to use the chloride of sodium, I would advise them to practice first upon a small quantity.

As a solution of nickel is composed of salts which have no caustic property whatever, metals to be plated require somewhat different treatment in preparing them for the bath. Thus, in coating steel or iron with nickel, deposition should not take place too rapidly at first, otherwise the metal will be liable to strip. It is also of the greatest importance that steel or iron articles should be placed in the solution immediately after being cleaned, as even a few moments exposure to the air or immersion in water is quite sufficient to cover them with an invisible layer of oxide, which would prevent the nickel from adhering closely to the other metal.

In preparing steel or iron work for the bath, they should be immersed in a boiling solution of potash or soda —I prefer the latter—after which they should be dipped for a few seconds in a solution of muriatic acid and water—acid, one-third; water, two-thirds—then scoured and rinsed; again dipped through the acid, rinsed, and immediately placed in the bath.

Brass articles, after being polished, require to be placed in the potash or soda for a short time only, then rinsed through a strong solution of cyanide, scoured, and immediately placed in the bath.

I have frequently found in some of the American potash foreign matter, which has a tendency to rust steel or iron, and ofttimes have, after leaving steel work in the solution of potash for quite a time, discovered spots of rust visible in places; therefore, I prefer the soda, which, if made strong enough and used at a boiling heat, is sufficiently strong to remove any particles of grease.

Britannia metal and pewter articles, being inferior conductors, require vigorous battery power in order to induce the deposit to take place promptly, which, after they have been struck, as it is termed, the battery power may be slightly reduced, and the articles allowed to remain in the bath to acquire the necessary thickness of deposit without being disturbed.

Steel work, to be polished, I find presents a much better color and appearance if a moderate coating of copper is deposited; and the article buffed prior to being placed in nickel bath.

In the preparation of brass or copper work for nickel plating, I prefer, instead of fine pumice, to employ ordinary whiting, which, while effectually cleansing the work, does not remove the polish; consequently, the article requires far less labor in finishing.

The failure of anthracite briquettes as fuel heretofore, because of the material not having been used in a sufficiently finely divided state, is now met by an invention brought forward by Biggs & Greenhow, of Glamorgan, Wales. According to this, anthracite small coal, "duff," is passed through a disintegrator, which will deliver it in such a condition that it will all pass through a sieve of at least twenty wires per linear inch, a finer condition being preferable; it is then mixed with about six per cent. of equally finely powdered pitch, and the mixture passed on to a pug mill, in which some six per cent. of coal tar or other liquid hydrocarbon is incorporated with the mass. The mixture prepared in this way is heated by superheated steam and compressed into briquette moulds at a pressure of about two tons per square inch. If it be desired to render the briquettes smokeless, they may be gradually heated to about 800° or 900° C. It is claimed for these briquettes that each cakes separately in the furnace, are hard, and are not deteriorated by rain.

SELECTED FORMULÆ.

Tobacco Soap.—Tobacco soap (Nicotiana soap) has been introduced in Germany for treating parasitic diseases of all kinds, particularly itch. The originator, P. Tauzer (Pharm. Centralh.), prepares an extract from tobacco refuse, containing about 8 per cent. of nicotine, of which he incorporates 10 per cent. in the soap, scenting slightly with oil of bergamot. This soap has proved excellent in allaying itching, and hence is expected to prove valuable in hives and pruritus. It must not be used on moist eczemas and pustulous affections, while on children it must be employed with great care.—Western Druggist.

Etching on Steel.—

1. Glacial acetic acid..................	4 parts.
Absolute alcohol.......................	1 part.
Nitric acid (sp. gr. 1·280)....	1 "

Allow the acetic acid and alcohol to remain mixed for half an hour, then add the nitric acid carefully. Etch from one to fifteen minutes.

2. Alcohol..............	3 parts.
Distilled water.......	5 "
Nitric acid	8 "
Silver nitrate........................	8 "

Wash the plate with very dilute nitric acid, and apply the solution for three minutes; then wash with a 6 per cent. solution of alcohol. Repeat if necessary.

3. Iodine....	2 parts.
Potassium iodide.....................	5 "
Water	40 "
4. Nitric acid	62 parts.
Water....	125 "
Alcohol........	187 "
Copper nitrate	8 "
5. Pyroligneous acid...	4 volumes.
Alcohol	1 volume.
Nitric acid.......................	1 "

Clean the steel and cover evenly with wax; cut the lines with a steel point through the wax, and pour on the etching fluid.

6. Iodine	16 parts.
Iron filings..................... ...	1 part.
Water.................	64 parts.

Digest until the iron is dissolved. Keep well stoppered until required for use.

7. Silver acetate......................	2 parts.
Alcohol.......	125 "
Distilled water................	125 "
Nitric acid...........	65 "
Nitric ether	16 "
Oxalic acid....	1 part.

Nitric ether is directed to be made by mixing one volume of alcohol with one volume of nitric acid, and stopping the reaction by adding four volumes of distilled water.

8. Fuming hydrochloric acid (sp. gr. 1·190).....	1 part.
Distilled water..........................	19 parts.
Solution potassium chlorate, 1:50..	10 "

—Merck's Market Report.

Colored Polish for Leather.—A German patent for colored polishes for boots, harness, etc., specifies the following mixture: White bone ash, 46 parts; molasses or glucose, 92 parts; oil or grease, 9 parts; concentrated sulphuric acid, 12 parts; concentrated hydrochloric acid, 10 parts; yellow mineral color, 2 to 5 parts; azo color, ¼ part. The bone ash is finely ground and mixed with the molasses or glucose. The grease—which may be animal, vegetable or mineral—is then added, and finally the acid and then the color. This polish is applied with a brush as usual, and is said to give a peculiar brilliance to yellow leathers without alteration of their shade.—Oils, Colors, and Drysalteries.

Removal of Tattoo Marks.—Various methods suggested for removing tattoo marks have appeared from time to time in these columns. The Paris correspondent of the Lancet-Clinic mentions the following procedure: The principle of the method is to form a dermic destruction of the tattooed part. Here is how it is done: It is first necessary to paint over the tattooed marks with a concentrated solution of tannin; afterward, by means of fine needles, we make a series of pickings over the tattooed design. Over the surface thus picked we pass a stick of nitrate of silver. At the end of a few minutes we see detached the black pickings previously made, and know that the superficial layers of derma contain a tannate of silver. In order to assure success, this surface must be powdered with tannin two or three days. The end is very simple. After an inflammatory action, lasting two or three days, the picked parts turn black, forming a thin crust, very adherent to the deeper skin, but painless. At the end of from fourteen to eighteen days the scab falls off, and in its place a superficial red mark is seen, which gradually fades away until, at the end of a few months, all signs of coloration disappear. Dr. Baillot also suggests the use of binoxalate of potassium in place of nitrate of silver. Of course, antiseptic precautions are all taken in performing this operation, and the old tattoo needle is used to remove all tattoo marks.

Relief of Thirst and Dryness of Mouth.—Thirst and great dryness of the mouth in sickness is often relieved by a teaspoonful of powdered gum Arabic, beaten thoroughly with a couple of teaspoonfuls of glycerine, to which is added a glass of cold water and enough lemon juice to make the mixture palatable. The mixture may be taken freely, with great relief to the dryness of the mouth and thirst.—N. Y. Med. Times.

Malted Food for Infants.—Practice appears to vary considerably with regard to the amount of malt in prepared infants' foods, as little as 5 per cent. being used in some cases.

Baked wheat flour.........................	10 oz.
Ground malt	2 "
Sugar of milk..........................	4 "

There is no necessity to add phosphates. A more palatable food can be prepared by adding desiccated milk, but this, of course, is not essential, as fresh milk is always added before use. Dry all the ingredients before mixing, by spreading on large flat dishes in a moderately cool oven.—Pharmaceutical Journal.

ENGINEERING NOTES.

Guardiamarina (midshipman) Riquelme, the fourth 30 knot torpedo boat destroyer built for Chile, was launched recently from Laird's yard at Birkenhead, making the eighth 30 knot boat they have built in nine months.

A committee of the Paris Municipal Council is now negotiating with the omnibus company with the object of substituting mechanical power for tramway and omnibus horses. On various tramway lines electricity, compressed air, and steam are employed, but the council thinks it desirable that not only should the tramcar be drawn by mechanical power, but that the omnibus should also be replaced by horseless vehicles. The omnibus company does not demand an extension of its concession in order to effect the reform, but it insists upon the signing of an undertaking for the purchase of its rolling stock and plant by the town of Paris at the expiration of its concession in the case of its not being renewed.

The iron industry in Southern Russia is rapidly developing, thanks, to a great extent, to the investment of Belgian capital. At the initiative of Belgian capitalists one iron works is built after the other, but although the bulk of the requisite money appears to hail from Belgium, home capital is also being invested in the same undertakings on no small scale. Not only are new works erected, but old ones are bought and extended; as an example may be mentioned the engineering works of Eson & Company, close to Iekaterinoslaw, which has been transformed into a branch of the new firm "Aciere du Midi de la Russie," where the first cast steel manufactory in the south of Russia will be installed. Another new manufactory is the one of the Société Metallurgique d'Estampage, close to the Nishne-Duleprowsk Railway station, on the Iekaterinen line, which, as the name indicates, will go in for stamped articles, bolts, screws, etc. The Parisian firm of "Barrican" is building a machine factory at Nickolajew, and numerous other projects of a similar nature are in a more or less advanced stage. This universal impetus to new industrial undertakings is not confined to the iron industry alone. The Drewitzky coal mines have also been sold to a Belgian syndicate, and two other Belgian companies have been formed for the purpose of erecting glass manufactories in Southern Russia.

As the development of various gold fields is seriously hampered by scarcity of the water which is necessary in the process of extraction, the advantages of a system in which water is not required would be considerable, says the Colliery Guardian. A plan recently suggested by Mr. W. H. Hyatt consists in subjecting the auriferous material to the action of a spray of mercury. The apparatus consists of a wide iron pipe bent into a spiral and containing at the bottom of each bend a quantity of mercury, which does not completely close the passage. Into this the ore, reduced to a fine state of division, is fed by a hopper and blown through by a current of air. This current, in conjunction with the curvature of the pipe, forces the mercury into the form of spray, in which condition it comes into intimate contact with the particles of gold contained in the powdered ore that is being blown through the apparatus. Amalgamation results, gold being retained by the mercury. The dust is carried on to the next bend, where it undergoes a similar process, and so on through as many bends as may be necessary for the particular material under treatment. In a trial of coarse gold dust artificially mixed with silver sand, the bulk of the gold was recovered at the first bend. But if the gold is in an exceedingly fine condition, as happens, for instance, with argillaceous ores, very much more passes the first bend and must be arrested later.

Of all the European countries, Austria is said to be the only one where the use of cast iron wheels for railroad purposes is not now prohibited by law, and where consequently their manufacture has not entirely been killed, says the Railway Review. Those laws originated at a time when the makeup of such wheels was far from the present state of perfection as manufactured in the United States. That cast iron wheels are, nevertheless, well liked wherever they are actually used is proved by the fact that the Austrian government, during the past year, asked its representative in the United States to make an investigation of the American practice. As a result of this investigation the Austrian government railways placed an order with an American wheel maker for 120 car wheels of the standard size, for the express purpose of using them on freight cars with brakes. The lot has been delivered, but cannot be used elsewhere than within the Austrian boundaries. If by these trials, and with reference to the American practice, the European officials can be induced to abolish the prohibition of cast wheels, there would be a bright prospect for the export of cast iron wheels to Europe, as the necessary experience and skilled labor, as well as the requisite machinery, cannot be had anywhere in Europe. This trade would, of course, be limited to Austria for the present, so far as railroads are concerned, and to street railway equipment.

To file hand saws proceed as follows, says a correspondent in the Wood Worker: First clamp the saw, then join it with an 8 in. or 10 in. mill file, until it is perfectly straight, or if much worn in middle, to a true curve, and touch every tooth. Then take saw out of clamp and set it. If there are any kinks in it, take them out before filing. Return saw to clamp, take a good three cornered file, hold it to file from heel to point and at an angle to give a good fleam on the face of teeth. Give a little more pitch to front or face side of teeth. Hold the handle end of file a little lower, filing from heel to point. Some people prefer to file from point to heel. If you file that way, hold file about level crosswise of saw. File in alternate spaces, first the side that needs most filing, which can easily be seen after jointing. Endeavor to make spaces all of same size. Do not file down to sharp points on first side nor on the other at first. Be careful to leave a little of the bright point for a third and finish course. Examine saw before finishing and see which side has largest spaces; then finish on the other side. After you have the saw evenly filed and set take a knife and scrape off wire edge; then lay the saw flat on a straight board and run a good flat file lightly over the sides of points (for a side file), just enough to touch them up and have them all in line. Do not get in too much set; make it so that it will cut smoothly and straight, and you will not need much.

ELECTRICAL NOTES.

According to the official returns of the Italian Ministry of Posts and Telegraphs, the number of messages sent over the wires during the last half of 1895 was 22,002,206. This includes dispatches on the Red Sea line (Massowa and Assab). The revenue was about £27,500, no allowance being made for government or service messages.

Hermitine, or electrolyzed salt water, besides its use as a disinfectant for sewage, is now employed as an antiseptic in Paris hospitals. Dr. Proger, chief surgeon of the Deaf and Dumb Children's Asylum at Asnieres, recently told the Academie de Medicine, as the result of long experiments, that "the electrolyzed saline water is neither caustic nor irritating; it may be applied to the mucous membrane as to the skin; it instantly removes all bad odors; stops all putrescent fermentation; kills microbes more effectually and rapidly than any other antiseptic; cleanses and heals fetid wounds and sores, and hastens healing; it is an ideal antiseptic. Consequently, it appears to me of the utmost importance to make it known, and to draw attention to all the applications that it may be put to both from a domestic point of view for deodorizing and cleaning, and from a medical point of view as an antiseptic and healer par excellence." Dr. Proger used hermitine with success in cases of angina, coryza and incipient diphtheria as well.

From European sources now comes a more definite report of the experiments carried out by M. Yaux, of Strasburg, in the presence of a committee of engineers. It appears that a drill tempered by electricity penetrated through a piece of steel quite as quickly as a drill of the best quality of steel tempered in the ordinary manner would have done, and a circular saw tempered by electricity severed bars of iron with a remarkable degree of ease. With shears of electric steel a bar of steel one and three-eighths inches wide and three-fourths of an inch thick was cut in two in a cold state, the same operation being repeated five times on the same bar, with no alteration whatever observable on the edge of the shears; and a simple table knife, tempered by this new process, cut eleven times in succession a piece of iron wire one and a half millimeters thick as easily as if it had been a piece of string. All the explanation given of this process consists in the statement that the tools are dipped, after being heated, into a conducting bath traversed by electricity.

The first application of the three-phase system for traction purposes has recently been realized at Lugano, Switzerland, says the Engineering and Mining Journal. The generating station is situated near Maroggia, at a distance of 12 km. from Lugano. It utilizes the hydraulic power of the Arogno torrent. A three-phase generator of 150 horse power is driven from a 300 horse power turbine, thus allowing of the installation of a second turbine. The frequency is 80, and the working pressure 5,000 volts. The exciter is direct coupled to the alternator spindle. At Lugano the pressure is transformed down to 400 volts. The cars carry a double trolley, and the rails are utilized as one conductor. The use of the three-phase system, it is claimed, offers the following advantages: The tranmission of power from a distant source of power, the elimination of commutators on the motors, the speed of the cars remains constant, irrespective of load or gradient. At Lugano the maximum speed is 15 km. per hour. A hand regulator allows intermediate speeds to be obtained. The absence of any electrolytic action is also a great advantage. The chief disadvantage of the system is the use of two overhead conductors and a double trolley.

The large waterfalls of the United States are now nearly all being utilized for the commercial development of power, which is transmitted electrically to some distant point. The power of the Lachine Rapids of the St. Lawrence River is to be so utilized. A large wing dam under construction runs out for more than 1,000 feet into the St. Lawrence River, by means of which a fall of water is secured sufficient to develop at the low water season 15,000 horse power. Upon the dam a power house will be built, which will run its entire length, and show an unbroken interior 1,000 feet long. The basement of this will be occupied by water wheels. The main floor will contain the dynamos, of which there will be twelve, each of 1,000 horse power, or a total capacity of 12,000 horse power. The dynamos, of the General Electric Company's latest multiphase type, will generate current for transmission to Montreal, for use there in lighting the city, operating the street railroads, and for private commercial use. The contract for the electrical installation is very large, and, notwithstanding the fact that it was competed for by the leading firms of the world, it was awarded to an American company on account of the superior apparatus.—Mining and Scientific Press.

The Gas World quotes from an article by S. Freund in the Zeitschrift fur Elektrotechnik. He says there are two kinds of lamps made, one of which the makers do not readily dispose of, because the public does not understand them, and the electric lighting companies do not like them, these being the short life and low consumption variety. A lamp which is not expected to last more than 300 hours may be made to use only 2·5 to 2·8 watts per candle to begin with, and from 3·2 to 3·5 watts after 350 hours. During 800 hours, such a lamp, with an average consumption of 2·85 watts, and renewals every 300 hours, each lamp costing 1s. 3d., with current at 5d., would cost 17s. 10d. On the other hand, the usual lamp begins with 3·5 watts per hour, or, in the English makes, 4 watts, a circumstance which contributes to the so-called solidity of the English make; and in 800 hours it reaches 5·3 to 6·2 watts per candle. Taking the average at four, and one renewal every 800 hours, the cost of lighting for 800 hours, with current at 5d., and lamps at 1s., is 22s. 4d. But observe that the candle spoken of is the Hefner unit; so that we would have, in round numbers, to add 10 per cent. to the consumptions per candle spoken of by Herr Freund. He says that at the end of the 800 hours' service of the coarser lamp its lighting power has fallen by 35 to 40 per cent., while at the end of the 300 hours' service of the other kind, it has only fallen from 18 to 20 per cent.

MISCELLANEOUS NOTES.

A miner in the Dolcoath mine, at Camborne, Cornwall, recently fell 120 ft. down a shaft without hurting himself. The explanation offered is that there was a strong current of air rushing up the shaft at the time.

Though Italy leads the rest of Europe in suicide as well as in homicide, Russia is ahead of her in the proportion of professional men, especially doctors, who take their own lives. Most of these are men between 25 and 35 years.

During the year 1895 there were published in France 10,115 new books, of which 153 were in philosophy, 473 in political and social sciences, 1,141 in medicine, 267 in geography and anthropology, 76 in mathematics and 251 in natural science.

A German firm at Deuben, near Dresden, makes a lamp chimney in which there is a bulb at the upper instead of at the lower part, and in which the upper rim is cut obliquely. This, it is said, makes it much safer to blow a lamp out, and the flame is taller and steadier, so that the light is improved. The greater safety in blowing out will, of course, depend upon the blower blowing from the high part of the slanting top.

Hyde Park, the most distinctive of London parks, covers nearly 400 acres. The Paris Bois de Boulogne covers 2,200 acres. Central Park, the most distinctive of New York parks, covers 840 acres. Collectively, and including those parks in the suburbs, there are in London 22,000 acres of park land. Including as parks the neighboring forests of Fontainebleau, with 42,000 acres, and St. Germain, with 8,000, the park acreage of Paris is 172,000.

The first man who made a name as a woman's dressmaker was Rhomberg, the son of a Bavarian peasant from the neighborhood of Munich. One day in 1730 a beautiful carriage appeared on the boulevard of Paris, with an escutcheon in the shape of a pair of corsets and an open pair of scissors painted on the panel of each door. This was Rhomberg's coat of arms. He owed his rapid success to his genius for concealing and remedying defects of figure. He left an annual income of 50,000 francs a year to his heirs.

As some alterations were being made to the roof of a house on London Road, Dover, occupied by a Trinity pilot, an extraordinary discovery was made, the whole interior of the sloping roof being covered with honeycomb and honey, evidently the result of years of careful work on the part of many bees. The time it must have taken may be judged from the fact that the honey and comb runs into hundredweights. Much of it is black with age, but a great deal is good, and the removal of it in bucketfuls was watched with interest.

The discovery of an agent which allows soda soaps in spite of their sparing solubility to be used in place of potash soap for washing raw wool is announced by Rosehig, in the Farber Zeitung. He prepares this article from the by-products obtained in the manufacture of carbolic acid, and whereas twenty parts of a soda soap requires about a thousand parts of water for proper solution, the same quantity of soap may be dissolved in one hundred parts of cold water if five parts of the new solvent be added, and the soap does not separate out from the solution on addition of the customary amount of soda. After washing with soda, soap, and the new article, the wool has no smell. The article in question is supposed to be what is known as cresylic acid in caustic soda.

A unique kind of machine has been devised by the Woonsocket (R. I.) Machine and Press Company, by which continuous wool spinning is effected, thus rendering practicable the supersedure of the mule in spinning woolen yarn. This spinner is built of ninety-six spindles in a machine, and can be operated on the very highest of stock or that which is medium or low grade. And not only this, but one such machine of ninety-six spindles will, it is stated, spin as much yarn as will a mule of 400 spindles; consequently, saving floor space, power, and cost of labor, as the arrangement can be operated by a lady in charge, the same as is the case with a cotton frame, and the opinion of woolen manufacturers is that by the use of this spinner a mill will be able to effect an important saving in the production of its goods.

Writing on some remarkably ancient mills at Mantua, which was a flourishing city in the middle ages, a correspondent of the Miller says: "Mantua stands on two lagunes, and between the upper and lower of these a dike was constructed 700 years ago, and pierced with a number of arches. Over twelve of these arches are, and have been ever since the dike was made, twelve mills named after the twelve apostles. Each mill bears in front, over its entrance, a statue of an apostle, while a figure of Christ occupies a central position in the middle of a long line of statues. The water flows with great force along the dike to the lower lagune, and for the last 700 years this stream has served to grind the corn for the feeding of the multitude around." Presumably the roller milling system has not yet reached Mantua.

Something novel in the line of building material is produced at a mill in Christiania, Norway. This mill, says the Manufacturers' Gazette, Boston, began operations about two years ago, making roofing tiles, and is now shipping to different parts of the globe an article which is of acknowledged superiority in the way of "slates." Norway tiles, as they are termed, are made from wood pulp, which under a very high pressure is formed into thin cakes of sizes like the ordinary roofing slates. After a chemical treatment, which is the inventor's secret, the tiles becomes hard like brick, and acquire a deep black appearance, which gives a soft tone to houses with prominent roofs and gables. It is claimed for these tiles that they possess every advantage of the best slates now in use; their composition makes them light, durable, and not so liable to breakage as the ordinary slates; they are not subject to any expansion or contraction, and, when a roof is once covered with this material, it will serve for a good many years without any repairs whatever. The price, also, of these tiles is very low, admitting of a saving of some 35 per cent., as compared with the cost of other roofing.

NANSEN'S ACHIEVEMENTS.

WE present engravings of the intrepid explorer, Dr. Nansen, who has just returned from the highest northerly point ever reached by man, and of his good ship, the Fram, together with maps of the route which he hoped to pursue and of his actual route.

This latter map shows approximately Dr. Nansen's ship and sledge tracks in the Arctic Ocean. In the southwest corner the Fram passed through Yugor Strait, and on August 4, 1893, was in that part of the Arctic Ocean known as the Kara Sea.

It is always possible for vessels to pass through Yugor Strait in summer, but the Kara Sea is sometimes blocked with ice, and it was here that the Dutch circumpolar expedition lost their ship by crushing in the ice in 1881 and never reached their proposed station in Siberia. The fact that the last news heard from Nansen after his departure was that he was still in the Kara Sea led some persons to wonder if he ever got out of those dangerous waters at all.

But he did get out, and made as rapid progress to the east as Nordenskjold did on the Vega, in 1878.

DR. NANSEN.

Both reached Cape Chelyuskin, the most northern point of Asia, in the month of August. Then Nansen turned southward.

He was making for the mouth of the Olenek River, where, by his directions, a lot of dogs had been collected for him. We now know that a storm prevented him from reaching the coast and taking the dogs aboard. Why he did not call at the mouth of the Olenek was a mystery that gave much anxiety to his friends.

It was thought by many improbable that he had reached the New Siberian Islands, where he expected to find his north flowing current, and therefore that his plans had been thwarted at the very outset, and that he had probably pushed into the ice west of Cape Chelyuskin.

He, however, carried out his preliminary plans to the letter, except that he did not get all the dogs he wanted. From near the mouth of the Olenek River he proceeded toward the New Siberian Islands, and just a little west of the New Siberian Islands he entered the ice and his ship was soon frozen in. His drift to the northwest then began.

At the point of his journey near the New Siberian Islands he discovered that the depth of the sea had suddenly increased from 90 fathoms to 1,600 fathoms, and he found other depths of 1,900 fathoms, a remarkable discovery in view of the long prevailing belief that the Arctic Ocean was a very shallow sea.

The point, March 3, shows the place where Nansen and his comrade left the Fram. Thus far the Fram had drifted in the ice, from very near the place indicated by the line. But this drift was by no means in a straight line, as it is represented on the map.

Sometimes the Fram drifted south, if the wind persisted from the north. All that can be shown here is the mean direction of the drift. We get a vivid idea of the slow progress made when we consider that it took the Fram one year five months and twenty-two days to advance a distance in a straight line of about 470 miles. The prevailing winds were taking the Fram, not to the pole, but in the direction of northern Franz Josef Land and Spitzbergen.

DR. NANSEN'S ROUTE AS ORIGINALLY PROPOSED.

The starred line shows course of driftwood from the Jeannette.

It took him twenty-five days to travel from the Fram to his highest north, and the distance was about 145 miles. Two men in woolen clothing, with two dog teams, have therefore approached within about 250 statute miles of the North Pole.

It is impossible to show even with approximate correctness Nansen's sledge route from the point marked April 7 to Franz Josef Land, partly because he was not able to take any longitudes for much of the way and partly because Payer's map of that country, the only one we yet possess, has been found both by Jackson and Nansen to be inaccurate both in its delineation of the Archipelago and also in the geographical position assigned to the islands.

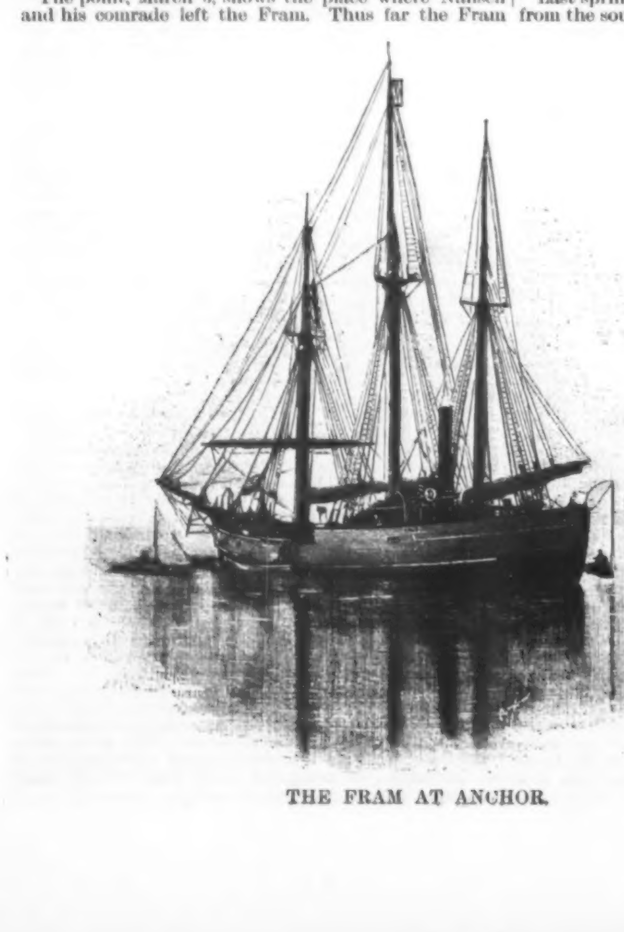
Last spring he started southward, intending to set out from the southern coast of Franz Josef Land for Spitzbergen, which he felt sure would be visited by one or more vessels during the season. On the way he happily met Jackson, who had wintered at Franz Josef Land, and the intrepid explorer returned to Europe on the vessel that had just renewed Jackson's supplies.

A cable dispatch from Christiania, Norway, dated August 20, states that the Fram has arrived safely at Skjervol, a fishing post on the bay near the North Cape. She drifted to the north nearly two degrees, and her highest north was less than twenty miles south of the most northern point he attained. The highest latitude reached by the Fram was 85° 57'.

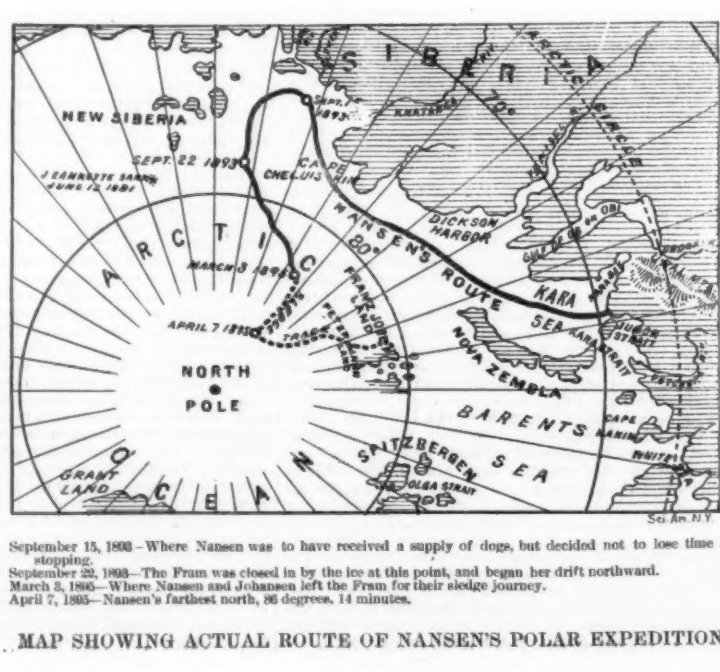
Dr. Nansen sent a signed statement of the progress and results of his expedition, which was printed in the London Chronicle. Dr. Nansen says:

"The Fram left Jugor Strait on August 4, 1893. We had to force our way through much ice along the Siberian coast. We discovered an island in the Kara Sea and a great number of islands along the coast of Cape Chelyuskin. In several places we found evidences of a glacial epoch, during which northern Siberia must have been covered by inland ice to a great extent.

"On September 15 we were off the mouth of the Olenek River, but we thought it was too late to go in there to fetch our dogs, as we would not risk losing a year. We passed the New Siberian Islands September 22. We made fast to a floe in latitude 78° 50' north and in longitude 133° 37' east. We then allowed the ship to



THE FRAM AT ANCHOR.



September 15, 1893—Where Nansen was to have received a supply of dogs, but decided not to lose time by stopping.
September 22, 1893—The Fram was closed in by the ice at this point, and began her drift northward.
March 3, 1895—Where Nansen and Johansen left the Fram for their sledge journey.
April 7, 1895—Nansen's farthest north, 86 degrees, 14 minutes.

MAP SHOWING ACTUAL ROUTE OF NANSEN'S POLAR EXPEDITION.

be closed in by the ice. As anticipated, we were gradually drifted north and northwestward during the autumn and winter from the constantly exposed and violent ice pressures, but she (the Fram) surpassed our expectations, being superior to any strain.

"The temperature fell rapidly and was constantly low, with little variation for the whole winter. During weeks the mercury was frozen. The lowest temperature was 62° below zero. Every man on board was in perfect health during the whole voyage.

"The electric light, generated by a windmill, fulfilled our expectations. The most friendly feeling existed, and time passed pleasantly. Every one made pleasure his duty, and a better lot of men could hardly be found. The sea was up to 90 fathoms deep south of 79° north, where the depth suddenly increased and was from 1,600 to 1,900 fathoms north of that latitude. This will necessarily upset all previous theories based on a shallow polar basin. The sea bottom was remarkably devoid of organic matter.

"During the whole drift I had good opportunities to take a series of scientific observations, meteorological, magnetic, astronomical and biological; soundings, deep sea temperatures, examinations for the salinity of the sea water, etc. Under the stratum of cold ice water covering the surface of the polar basin I soon discovered warmer and more saline water due to the Gulf Stream, with temperatures from 31° to 33°. We saw no land and no open water except narrow cracks in any direction. As anticipated, our drift northwestward was most rapid during the winter and spring, while the northerly winds stopped or drifted us backward during the summer. On June 18, 1894, we were on 81° 52' north, but we drifted then southward only. On October 21 we passed 82° north. On Christmas eve, 1894, latitude 83° north was reached, and a few days later 83° 24', the furthest north latitude previously reached by man.

"On January 4 and 5 the Fram was exposed to the most violent ice pressures we experienced. She was then firmly frozen in ice of more than thirty feet of measured thickness. This flow was overridden by great ice masses which were pressed against the port side with irresistible force and threatened to bury it if not to crush her. The necessary provisions with the canvas kayaks and other equipments had been placed in safety upon the ice. Every man was ready to leave the ship if necessary, and was prepared to continue with the drift, living on the floe. But the Fram proved even stronger than our trust in her. When the pressure rose to the highest and the ice was piled up high above the bulwarks, she was broken loose and slowly lifted out of her bed in which she had been frozen, but not the slightest sign of a split was to be discovered anywhere in her. After that experience I consider the Fram almost equal to anything in the way of ice pressures. Afterward we experienced nothing more of the kind, but our drift was rapidly continued north and northwestward.

"As I now with certainty anticipated that the Fram would soon reach her highest latitude north of Franz Josef Land and that she would not easily fail to carry out the programme of the expedition, viz., to cross the unknown polar basin, I decided to leave the ship in order to explore the sea north of her route. Lieut. Johansen volunteered to join me, and I could not easily have found a better companion in every respect. The leadership of the expedition on board the Fram I left to Captain Severdrup. With my trust in his qualifications as a leader and his ability to overcome difficulties, I have no fear that he will bring all the men safely back, even if the worst should happen and the Fram be lost, which I consider improbable.

"On March 3, we reached 84° 40' north. Johansen and I left the Fram on March 14, 1895, at 83° 59' north and 102° 27' east. Our purpose was to explore the sea to the north, and to reach the highest latitude possible, and then to go to Spitzbergen via Franz Josef Land, where we felt certain to find a ship. We had twenty-eight dogs, two sledges, and two kayaks for possible open water. The dog food was calculated for thirty days and our provisions for 100 days. We found the ice in the beginning tolerably good traveling, and so made good distances, and the ice did not appear drifting much.

"On March 22 we were at 85° 10' north. Although the dogs were less enduring than we hoped, still they were tolerably good. The ice now became rougher and the drift contrary. On March 25 we had only reached 85° 19' north, and on March 29, 85° 30'. We were now evidently drifting fast toward the south. Our progress was very slow. It was fatiguing to work our way and carry our sledges over the high hummocks constantly being built up by the floes grinding against each other. The ice was in strong movement and the ice pressure was heard in all directions.

"On April 3, we were at 85° 50' north, constantly hoping to meet smoother ice. On April 4 we reached 86° 3' north, but the ice became rougher until on April 7 it got so bad that I considered it unwise to continue our march in a northerly direction. We were then at 86° 14' north. We then made an excursion on skis further northward, in order to examine as to the possibility of a further advance. But we could see nothing but ice of the same description, hummock beyond hummock to the horizon, looking like a sea of frozen breakers. We had had low temperature, and during nearly three weeks it was in the neighborhood of 40° below zero. On April 1 it rose to 8° below zero, but soon sank again to —38°. When a wind was blowing in this temperature we did not feel comfortable in our too thin woolen clothing. To save weight we had left our fur suits on board ship. The minimum temperature in March was —49°, and the maximum was —24°. In April the minimum was —38° and the maximum —20°. We saw no sign of land in any direction. In fact, the floe of ice seemed to move so freely before the wind that there could not have been anything in the way of land to stop it for a long distance off. We were now drifting rapidly northward.

"On April 8 we began our march toward Franz Josef Land. On April 12 our watches ran down, owing to the unusual length of the day's march. After that date we were uncertain as to our longitude, but hoped that our dead reckoning was fairly correct. As we came south we met many cracks, which greatly retarded our progress. The provisions were rapidly decreasing. The dogs were killed, one after the other, to feed the rest. In June the cracks became very bad, and the snow was in exceedingly bad condition for traveling. The dogs and the ski and sledge runners broke through the superficial crust and sank deep in the wet snow. Only a few dogs were now left and progress was next to impossible. But unfortunately we had no line of retreat. The dogs' rations, as well as our own, were reduced to a minimum, and we made the best way we could ahead. We expected daily to find land in sight, but we looked in vain. On May 31 we were in 82° 21' north, and on June 4 in 82° 18' north, but on June 15 we had been drifted to the northwest to 82° 26' north. No land was to be seen, although, according to Payer's map, we had expected to meet with Petermann Land at 83° north.

"These discrepancies became more and more puzzling as time went on. On June 22 we had at last shot a bearded seal, and as the snow became constantly worse I determined to wait. We now had a supply of seal meat until it melted away. We also shot three bears. We had only two dogs left, which were now well fed upon meat.

"On July 22 we continued our journey over tolerably good snow. On July 24, when about 82° north, we sighted unknown land at last, but the ice was everywhere broken into small floes, the water between being filled with crushed ice, in which the use of kayaks was impossible. We therefore had to make our way by balancing from one ice piece to another, and we did not reach land until August 6 at 81° 38' north and about 63° east longitude. This proved to be entirely ice-capped islands. In kayaks we made our way westward in open water along these islands, and on August 12 we discovered land extending from the southeast to northwest. The country became more and more puzzling, as I could find no agreement with Payer's map. I thought we were in longitude east of Austria Sound, but if this was correct, we were now traveling straight across Wilczek Land and Dove glacier without seeing any land near us.

"On August 26 we reached a spot in 81° 13' north and 56° east, evidently well suited to wintering, and, as it was now too late for the voyage to Spitzbergen, I considered it wisest to stop and prepare for winter. We shot bears and walruses, and built a hut of stones, earth and moss, making the roof of walrus hide tied down with rope and covered with snow. We used the blubber for cooking, light, and heat. The bear meat and the blubber were our only food for ten months. The bear skins formed our beds and sleeping bag. The winter, however, passed well, and we were both in perfect health. Spring came with sunshine and with much open water to the southwest.

"We hoped to have an easy voyage to Spitzbergen over the floe of ice and the open water. We were obliged to manufacture new clothes from blankets and a new sleeping bag of bear skin. Our provisions were raw bear meat and blubber. On May 19 we were at last ready to start. We came to open water on May 23, in 81° 5' north, but were retarded by storms until June 3. A little south of 81° we found land extending westward, and open water which reached west-northwest along its north coast. But we preferred to travel southward over the ice through a broad sound. We came on June 12 to the south side of the island, and found much open water trending westward. We sailed and paddled in this direction in order to proceed across to Spitzbergen from the most westward cape, but Payer's map was misleading."

Dr. Nansen then tells how he met Mr. Jackson, and he concludes:

"We left Franz Josef Land in the steamer Windward on August 7, and had a short and very pleasant passage, thanks to the masterly way in which Capt. Brown brought his ship through the ice, and thence in the open sea to Vardoe. NANSEN."

THE BRIDGES-LEE SURVEYING CAMERA.

WE illustrate a surveying camera constructed by Mr. James J. Hicks, of 8, 9, and 10 Hatton Garden, London, E. C., and which has already been used with advantage in India. The leading idea on which the camera is based is the simultaneous photographing, on the same plate, of the picture required, and of the magnetic bearing of its central vertical plane. The instrument consists of a strongly made brass bound box camera, fitted with a rectilinear lens working in a focusing sleeve, and the usual ground glass screen, on which the picture to be taken can be sharply focused. The camera body turns on a horizontal plate having a graduated rim, over which a vernier attached to the camera slides, thus permitting horizontal angles to be read when desired. A clamping screw, shown to the front of Fig. 1, fixes the camera body to the bottom plate when necessary. This bottom plate is mounted on a tripod head provided with leveling screws. On the top of the camera body there is, in the first place, a rotating level, and secondly a telescope mounted on a horizontal arm, and fitted with a rack adjustment and a scale allowing vertical angles to be taken. The vertical cross wire of this telescope bisects the picture seen on the ground glass screen, and is co-planar with a second vertical cross wire inside the body of the camera, clearly shown in Fig. 2. The shadow of this cross wire shows up clearly on the plate when developed, and thus marks the center line of the picture. Behind this wire is a compass mounted on a rack inside the camera, by means of which it can, when a photograph is to be taken, be moved back until it justs fails to touch th plate. The graduation of the compass card is carried out on a vertical strip of translucent material, through which the light passes to the plate, thus photographing thereon the compass bearing. The horizontal fiber also shown in Fig. 2 is marked on the plate, similarly to the vertical one, and when the instrument has been properly leveled it indicates thereon the true horizon. The instrument, with four double backs, packs into a leather case, and is not more troublesome to carry than an ordinary theodolite or level. For our engraving we are indebted to Engineering.

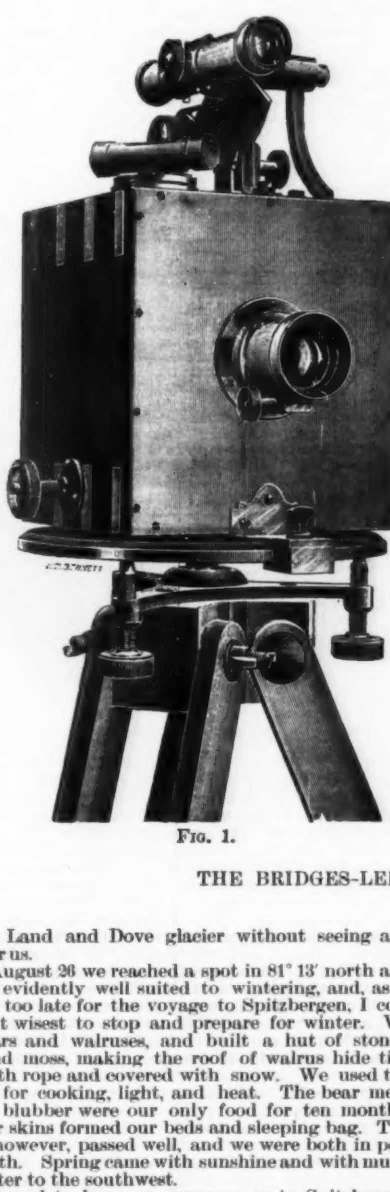


FIG. 1.

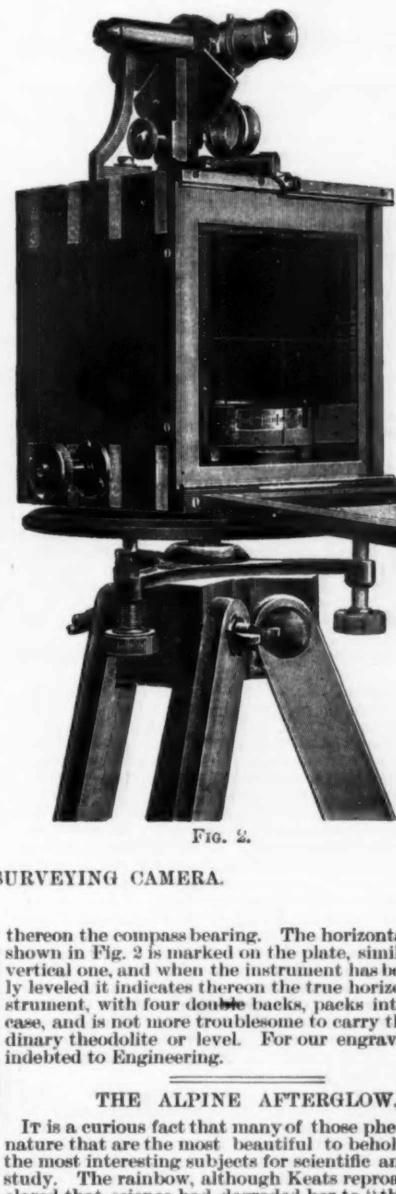


FIG. 2.

THE BRIDGES-LEE SURVEYING CAMERA.

THE ALPINE AFTERGLOW.

IT is a curious fact that many of those phenomena of nature that are the most beautiful to behold are also the most interesting subjects for scientific analysis and study. The rainbow, although Keats reproachfully declared that science had degraded her to "the dull catalogue of common things," is certainly none the less lovely because we know the exact path of the sun's rays through the rain drops, neither is the orchid less beautiful since Darwin's researches on the fertilization of flowers by insects. So when we read that scientific men have analyzed and explained the beautiful Alpine afterglow that so many travelers have gazed on with admiration, we need not fear that it will now lose its beauty. The phenomenon has long been studied, but it has acquired fresh interest from a new theory somewhat at variance with the old ones. The whole matter is set forth and discussed by M. H. Dufour, in an interesting article in the Revue Scientifique (Paris), which the Literary Digest translates, in part, below:

"An observer looking at the Alps when they are lighted up by the setting sun sees the hues of the rocks and the snows changed into tones of golden yellow and purple while the sun is setting behind him; these tones turn more and more toward red as the sun sinks, and they diminish in intensity as their boundary rises on the mountain side, till finally only the summits glow, and then all tint of yellow or pink vanishes. Soon after

this disappearance of direct illumination the mountain appears pale, the hues of the rocks are of a greenish gray, the snow is a dull white; it seems that no more coloration is possible. Nevertheless, it sometimes happens—the phenomenon is by no means constant—that the mountain lights up anew, at the end of a number of minutes that varies with the altitude; it assumes again a rosy tint, more subdued than that due to the sunset, but of considerable brilliancy. This color vanishes like the first, lingering last upon the summits. It is this new illumination, separated by a period of obscurity from that which is due to the last direct rays of the sun, that is called in the Alps the 'second coloration,' or often simply the 'coloration;' Necker de Saussure calls it the 'recoloration.' The German name of Alpenglühen is not applied necessarily to the recoloration, for which the term Nachglühen [afterglow], indicated by Von Bezold, ought to be reserved.

"In some very rare cases, after a weakening of the recoloration, there is a new increase of light of a more purplish hue than the preceding, less intense and more diffuse.

"While this phenomenon is taking place on the part of the mountain facing the sun, the characteristic tints of sunset are produced in the west. Their succession has been very exactly described; . . . we shall not reproduce these descriptions, but note simply that when the sun is 4 to 5 degrees below the horizon a purple hue begins to be added to the yellow coloration of that region of the sky where the sun has disappeared. This purple color, called by Von Bezold 'the first purple light,' is very brilliant; 'it colors in red the objects placed before the observer whose back is turned toward the sun,' says this author.

"We may add that this coloration of sunset coincides in general with the recoloration of the mountains.

"It is this rose tint of sunset which, according to the majority of authors, is the true cause of the coloration of the mountains, which are illumined under the influence of the light in the region of the sky opposite them. . . .

"M. Amsler explains the phenomenon of the second coloration by referring it to a direct action of the solar rays; he holds that, in certain favorable conditions, when the air has been powerfully heated, the temperature may fall rapidly as we rise, so that the index of refraction of the air becomes greater with the height in spite of the diminution of pressure, and that at the moment of sunset the refracted rays rise, forming a convex line at the side of the sun. It results that for low regions the sunset occurs sooner than it should and the obscurity that accompanies it rises gradually. After this period of the phenomenon, a cooling of the mass of the atmosphere taking place, the rays of the sun do not undergo the same bending and enter again into the darkened area, producing a second coloration which is the 'recoloration.'

"This new illumination begins below and rises gradually. To support his explanation, M. Amsler cites the fact of an observation of the reappearance of the sun after an apparent setting.

"M. Maurer raises numerous objections against the theory of M. Amsler, among others the following: 1. The improbability of a lowering of temperature as great as that demanded by the theory to explain the recoloration. 2. The fact of the simultaneous appearance of the intense hues of the sunset and those of the second coloration, and the fact that when the luminous phenomena of sunset are very intense, as in the winter of 1883-4, the coloration of the Alps was also very intense. 3. The fact that the meteorological conditions of February, 1894, when beautiful recolorations were observed, were not at all favorable to the rapid fall of temperature required by Amsler's theory. . . ."

To these criticisms M. Amsler has just made answer as follows:

"[He] acknowledges that it is probable that often the luminous phenomena of the Alps may be explained by the purple tints of sunset or by the presence of bands of clouds, but asserts that this explanation does not suffice to account for the intensity and color of a certain number of phenomena observed by him. He remarks, besides, that the variations of temperature necessary to produce the phenomena of refraction on which the theory rests are much less than one would at first suppose; 0·01 to 0·03° [Centigrade] to the meter [yard] are sufficient to obtain a pronounced rise in the course of the rays as they traverse the layer of air. The conditions of rapid variation of temperature within a small height should often be realized, and he cites several manifestations of this, though they cannot be otherwise proved except by meteorological observations, which give us no information on vertical variations of temperature. But the most important fact is a new, well authenticated observation of two successive settings of the sun, by M. Hefti Ruch, at the Rigi Kaltbad. This observer was struck with the phenomenon, which had attracted his attention for the first time, though he had observed, he says, numerous Alpine glows.

"We may conclude, as M. Amsler himself does, that it is probable that two different phenomena may cooperate in producing a second glow after sunset, the one being the general illumination due to the coloration of sunset, . . . the other probably more rare, being the phenomenon of refraction studied by M. Amsler. The first would be a general phenomenon; the second, more localized, would be observable only in a limited number of cases.

"Several signs permit us to recognize one from the other. M. Amsler himself indicates some of them. The phenomena of the second illumination of the Alps after sunset will be a general phenomenon, taking place equally on all visible summits, if it is produced by the colors of the sunset, for this optical phenomenon of high atmospheric regions will illumine all the Alps, and will be independent of the local atmospheric conditions of the lower layers.

"The second coloration studied by M. Amsler will be, on the contrary, much more local, and dependent on the special conditions of the atmospheric layers of the lower regions; it might be, on the same evening, intense in one region and feeble in another."

In conclusion, M. Dufour calls for additional observations to clear up the subject, and he closes as follows:

"We believe that it would scarcely be scientific, in presence of the facts of observation, to reject without further study the explanation that M. Amsler proposes for a certain number of cases of recoloration; his ingenious hypothesis, on the contrary, invites new observations as precise as possible. If this result be attained, the discussions that this new theory of the Alpine glows has raised will teach us to know better one of the most beautiful optical phenomena of nature."

ERNST CURTIUS.

PRACTICALLY Dean of the Faculty of the University of Berlin for many years back, Prof. Du Bois-Reymond is to-day suddenly the actual Dean, for but yesterday there fell a very famous column of the university, the veteran Ernst Curtius, says the Berlin correspondent of the New York Times, referring to the recent death of Prof. Curtius, the great archæologist. One who saw him at the festival in honor of the artist Adolf Menzel last winter could scarcely have taken Curtius for a man of over fourscore years of age. He was one of the standing proofs of the saying that "professors never die." The "fragrance of books," as the Chinese poetically express it, seems to act like an elixir of life. Prof. Curtius is best known in the United States as the author of the "History of Greece," which appeared between 1857 and 1861. But perhaps it may be more readily recalled that to his efforts was it due that Germany gave $200,000 for the excavation of Olympia, in Greece, from 1875 to 1881. In recognition of this fact, a bust of Curtius has been placed on the scene of the great digging.

What a preparation Curtius had for his Greek history and archæological successes! His life is a good sample of Prussian thoroughness and industry. Born in the old Hansa town of Lubeck, of one of those pompous old burger families which supply so many professional chairs, as a young man who had tried the merits of Gottingen, Bonn, and Berlin Universities, Ernst Curtius happened at Bonn to attract the notice of the philosopher Brandis, who accompanied the newly made King Otto of Greece to Athens as classical guide and friend, as well as philosopher. Curtius went also, as tutor to the Brandis children. In Athens he met the poet, Emanuel Geibel, there as a tutor likewise, and formed a traveling and publishing partnership with him. Their joint work is "Classical Studies."

Curtius was in Athens from 1837 to 1840, when Europe

ERNST CURTIUS.

was still thrilling with the Greek revolution, but when Greece itself had settled down to a nap under a Bavarian kinglet. He passed the winter of 1840 in Rome with Abeken, took his degree at Halle in 1841, and became Privatdozent at Berlin University soon after.

It was then that he first showed his eloquence. He was considered in that point only surpassed by his junior, Emil du Bois-Reymond. In the fifties Curtius published a dozen works on the Peloponnesus, including an exhaustive account of its geography, history and antiquities. At his lectures he had the future Emperor Frederick III, who, notwithstanding his intense and absorbing ambition as Crown Prince to put the Hohenzollerns on the imperial throne (it is known from his diary that he, not Bismarck, was the mainspring in this), found time to interest himself in classical as well as modern art. Among the notable bits of eloquence by which Curtius fired his listeners to action in the resurrection of ancient Greek art was that on Olympia (1852).

Although Curtius moved to a chair at Gottingen in 1856, his work was still carried on. In the next year appeared the first volume of his "History of Ancient Greece," a work translated into many languages, and since its appearance a standard ranking with Mommsen's "History of Rome." In 1862 he visited Greece again, and published the famous seven maps; in 1868 he was called back to Berlin, where he had since been professor of the history of ancient art and director of the department of antiquities at the museum.

Curtius had been failing in health for some time, but the end came suddenly after all; it came fortunately, however—he fell asleep with but little apparent suffering, and surrounded by his family.

The influence of Ernst Curtius has been so great that it is hard to realize its extent. In reviewing his sixty years of labor, however, one comes to understand that Athens would not to-day be the home of many a classical school for the instruction of foreign students in ancient art if the persistent enthusiasm, eloquence, and unflagging energy of utterance and publication of Curtius had not been all this while at the back of the movement. Of course there are many points in his history of the ancient Greeks to which exceptions have been fairly taken. This was inevitable with the widening of our horizons as the knowledge of early Oriental and European civilization grew, keeping pace with the revelations of excavations in Greece and elsewhere, and with the better understanding of living nations who are in some ways and to some degree living parallels of the old Greeks. But his work presents in a comparatively lifelike and lively way the ancient Greeks as a whole, and yet distinguishes their component parts, one from another, with no little distinctness. To properly appreciate the work, his smaller books on separate questions, such as his treatise on Greek highways, on the island of Naxos, and on Artemis the Health Giver, should be examined as well. For our portrait of Prof. Curtius we are indebted to Uber Land und Meer.

$250 PRIZE ESSAY COMPETITION—THE PROGRESS OF INVENTION DURING THE PAST FIFTY YEARS.

Sixth Prize, won by A. MALCOLM (A. M. FARLOW).

THE nineteenth century has been pre-eminently the age of electricity and steel, and the application of these colossi of modern advancement to the onward impetus of mechanics and art has characterized the last half century as the world's best record in the display of inventive genius. The United States, with her intense interest directed to the practical demands of an enlarged and scientific agriculture and the advancement of her unexcelled natural resources, has been called upon to minister to the necessity of facilitated processes in manufacture and the economy of time in transportation and architecture. English genius, centered upon the needs of a commerce and manufacturing industries, has been impelled to perfect her devices more for the perpetuation of their maritime power than in the spirit that attunes American needs to "Yankee ingenuity."

The inventions of the past have each in turn contributed its light to the development of greater principles. The nation most renowned in industrial and civic greatness is the one most facile in shaping crude resources into res utilissimæ. Fifty years have marked marvelous achievements in human research. That fifty years to come will be less productive in the richness of resultant blessings we cannot say. The present status of philosophic research indicates that nature will more and more yield to the dominion of man.

The first invention of note under power not controlled by electricity was the work of Cyrus McCormick, whose reapers have since maintained a high standing under repeated improvements. The French Academy of Sciences declared that Cyrus McCormick had done more for the sake of agriculture than any man living. On the soil of Europe our binders and mowers are extensively used. Almost contemporaneous with the reaper came the social reformer and economic agent known as the sewing machine, patented by Elias Howe in 1846. Women whose work, previous to this new factor, had been long continued, excluding the time for literary advancement, at last found time for self-culture and the bestowing of inestimable comforts upon the sacred institution of home.

Means of facilitating agriculture were necessary to keep the harvest commensurate with population. The wooden plows of the Britons were not wholly considered antiquated at the middle of the present century. Teams such as Cincinnatus of old left harnessed to follow the call to war were at that time characteristic of rural scenes. The shadows of the middle ages were reluctantly receding and carrying with them old time customs, while the new day, the new inventive era, already "stood tiptoe on the eastern hills." The early inventions of the last five decades heralded wonders undreamed of. The old "jumpers" in farming were succeeded by the hoe, and this in turn by the planter and drill. Broad and fertile acres yielded a greater abundance for a fruitful commerce and an acerescent manufacture. Fetichism and inexplicable diseases of plants gave way to a greater science. Luxuries attendant upon improved agriculture have triumphantly lifted the menial serf to be the scientific farmer. The rusticus of Homer has departed from actual life. "Urbanity" is not in harmony with its derivation now. Tact and mechanical skill have exonerated the workman.

Between 1820 and 1846 the following remarkable inventions were made in this country: Blanchard's eccentric lathe, McCormick's reaper and mower, Colt's revolver, Ericsson's screw propeller, Goodyear's hard rubber goods, Hoe's steam printing press and Howe's sewing machine. The steam fire engine, friction matches, and the daguerreotype were wrought out in Europe during the same period. The full inflorescence of inventive skill, however, came after the mid point of the century had been passed. Hardly had the fiftieth year post of the century been left when Henry Bessemer perfected his invention of Bessemer steel by driving a blast of air through molten iron, thus eliminating the carbon. To state the effect of this revolutionizer upon the industrial world would be impossible. The fine temper of steel was never brought to such a degree of perfection at so little cost. The famous blades of the Moslems had now been rivaled. At the International Cotton Exposition might have been seen three tracks of the Atlantic Southern Railway. The first was a narrow gage of very small iron rails, the second of heavy iron rails, while the third showed the criterion of modern railroad construction, and finished the object lesson by presenting a track made of Bessemer steel rails of finest quality.

Stellar space, with all its mysteries, has been penetrated farther and farther. The skill of the Clarks, of Cambridge, in constructing the glass for the Lick telescope has placed Mount Hamilton at the forefront of astronomical discovery. The glass for the Chicago University has recently been brought to perfection by the same firm. This glass is forty-one and one-half inches in diameter, and when mounted the celestial sphere will have been penetrated along a longer radius than ever before. The ambrotype gave way to the paper photograph, which has made it possible to photograph the heavens—a stupendous work, but one destined to prove of incalculable worth to astronomical science. Bodies not found in this vast collection may at once be catalogued as new discoveries.

The spectroscope has been valuable in determining the composition of stars, nebulæ and atmospheres by spectroscopical analysis. The inventors were Gustav Kirchhoff and Robert Bunsen, and therefore it is of German origin. In the discovery of helium, Science

seems to have plucked one treasure from the mystic hand of Infinitude.

Light has drawn forth numerous inventions since the time of Archimedes' mirrors, but none surpasses the apparatus for emitting rays that penetrate opaque bodies, and which will probably rank skyagraphy, the crowning discovery of the age, and Roentgen, the inventor and discoverer, the esteemed benefactor of surgery.

A summary of inventions exclusive of those mentioned may be conveniently considered under (1) war material, (2) applications of steam, (3) electricity and (4) medicine including obstetrics and surgery.

The enginery of war has become far superior to the Krupp cannon and small arms of the civil war. Torpedo boats with automatic projectiles, steel guns with a penetrating power of forty-six inches of steel plate and rapid firing rifles are characteristic features of belligerents that would stamp a war at this time suicidal. Smokeless powder affords the eye a clear vision and a ready aim. Mines at the entrance of harbors would present an impassable barrier to an approaching foe. Explosives that fifty years ago would have created consternation are used with impunity as destructive agents of war and in quarries and mines of every land. The bicycle, largely calculated to enhance the development of stalwart physiques and aid in the transit of mails and light merchandise, is no less used in modern European armies, and on good roads in time of war, to facilitate the transmission of commands and dispatches.

Steam as a factor in locomotion has grown from an imperfect beginning to a well directed and economic agent in subserving the needs of man. The modern locomotive has almost annihilated distance. To leave Chicago at three o'clock A. M. and at ten P. M. attend a lecture in New York City is an actual possibility. The best car wheels are now of Allen paper, and the floors, built of non-conductors of sound, exclude the din of the rushing train. Vestibuled cars not only promote the comforts of passengers, but, should coaches become derailed, the tendency to overturn would be subverted. A derailed train of this description during our Columbian Exposition did not injure a single passenger, while, had the cars been disconnected, loss of life would have been inevitable.

For a long time the championship of fast running belonged to Great Britain. On the London and Northwestern Railway, from London to Aberdeen, a distance of 540 miles, an average speed of 63·93 miles per hour was maintained. This feat, performed by the Caledonian locomotive, with 78 inch drivers, received the jubilant laudations of the English press. On October 24, 1895, a run was made on the Lake Shore road, the primal object of which was to beat the English record. The engines used were built by the Brooks Locomotive Works, of Dunkirk, N. Y., after designs made by George W. Stephens, of the Lake Shore road. The unprecedented record of an average running time of 65·07 miles an hour for 510 miles was made, while the highest speed attained was 92·3 miles per hour. This record for long distances has not yet been excelled and is a tribute to American mechanics.

We have purposely left until the last consideration under railway application of steam what, in the opinion of every unbiased railroad man in our own or foreign countries, is the crowning individual triumph of American railroad invention and its most distinctive native production, the Westinghouse air brake. Dating in its first form from 1868, this apparatus fairly leaped into prominence. In the production of this appliance both inventive and technical skill of the highest order were required, and the result has been incomparably the greatest contribution to railroad management that has been offered since the first locomotive wheel was turned by steam. Traffic and passenger transit would be attended with such a loss and fatality under the old system of brakes that the high eminence of railway systems would never have reached their present status. The immunities and comforts of passengers, the comparative safety and withal low rates are potent incentives in removing the barriers of provincialism and in winning every citizen to an exalted plane in occultatu et humanitate.

As equally revolutionary has been the improvement of steamships. The early steamers contained boilers whose resistance did not exceed 12 pounds, while those recently built show a resisting power of not less than 200 pounds. Special types of boilers frequently exceed this. That slow time and sluggish commerce were the results under the old regime is not to be wondered at. The first Atlantic steamers made 8½ knots. In 1870 the speed was about 14½. By 1890 the Lucania, a Cunarder, made an average or 21·16 knots for 2,873 miles, making the passage to Sandy Hook in 5 days, 12 hours and 57 minutes. The Minneapolis won her laurels by making 23·07 knots on her trial trip in July, 1894.

The age of steam is obviously finite, however supreme its sway over the manufacturing world. While progress in the application of steam has unquestionably been the first problem of the nineteenth century inventor, a more economic factor is to be found in electricity. That Niagara Falls is able to furnish electric power to run all the manufactories extending 100 miles from herself as a center is not altogether an air castle in a dreamer's brain. The harnessing of this mighty torrent, already begun, is but the indication that all of Nature's forces have not yet passed under the control of man and that a more glorious conquest is to follow.

As a rule, inventors do not win celebrity at once, yet the exertions of Capt. Jonn Ericsson transformed all ideas of ironclads breve tempo. By extraordinary energy and consummate skill, 100 days after the laying of her keel, the Monitor was afloat. Much smaller in size than her contemporaries, a mere pygmy compared with the 70,000 tons burden of the Great Eastern, she was destined to effect a victory of mighty consequence. The lighter man-of-war surpassed in speed all the old ships of the line. "Without a doubt," writes Lieut. Commander Uriel Sebree, of the United States navy, in the November Chautauquan of 1894, "our little Petrel of less than 1,000 tons could alone whip a fleet such as Nelson had at Trafalgar in 1805." Ericsson invited the English Admiralty to take an excursion in tow of his boat (a screw steamer) in 1837. Although the then excellent speed of 10 knots per hour was made, the objection urged was: "Even if the propeller had the power of propelling a vessel, it would be found altogether useless in practice, because, the power being applied at the stern, it would be absolutely impossible to make the vessel steer." That Ericsson was subsequently induced to leave these "cold water pourers" and come to America proved a great blessing to our own land and the world at large.

Fifty years ago it took three weeks to send a message from New York to Liverpool and three months to Calcutta, which can now be accomplished in a few hours. Vast moving armies are no longer able to scale forbidding mountains and unsuspectedly assail an unwary foe. Nations may now reason together and thus altercations may be amicably settled. Dangerous fires are no longer possible in large cities. Electric currents herald the approaching danger, and the modern fire engine beats back the destroyer of homes. In case of war, dynamite would be the servant of this mighty force, both in torpedoes and submarine mines. Search lights would reveal occult movements of an enemy, while "quaker guns" would no longer terrify by the terrible effrontery of bogus cannon. Electroplating has supplanted the burnishing of iron, which is protected from corroding by nickel plate. The promulgator of current news, the newspaper, owes much to electrotyping. Electrolysis has been valuable to the mineralogist in extracting ores and to the chemist in decomposing liquids. Hallucinations concerning haunted houses departed at the coming of the electric door bell, his ratship no longer able to cause the mysterious peal at an unseemly hour.

Electricity has taught mankind the value of quick action in emergency. The ambulance corps places the unfortunate sufferer from accident under the physician's care; the fugitive from justice rarely escapes. Electricity can cause fires or prevent them, kill or save life, illumines forbidding streets, measures by means of the galvanometer a temperature variation of 0·00001°C. The microphone causes the footfall of the smallest insect to become distinctly audible, and the telautograph, as the Greek words τελος, αυτος and γραφω indicate, writes messages, itself far away, with accuracy. The phonograph, invented in 1877 and improved in 1886, successfully records sound, an invention that may permit posterity to listen to the words of their ancestors whose voices may have ceased to vibrate sound waves for centuries.

The debt which the world owes to electricity will no doubt be compounded at a high rate of interest. No science has allured so many great minds to contemplate its intricacies since the kindling of the stars or the creation of man.

Fifty years ago the average duration of life was about 38 years, now it is between 45 and 50 years. The increased longevity is due to both medical skill and invention. The laryngoscope and opthalmoscope broadened the field of surgery. Instruments used by the physician to-day in obstetrics with excellent results have reduced the death rate to less than five per thousand births; 300 years ago the rate was about 40. The hypodermic syringe has been the means of saving and prolonging life, especially when the passage into the stomach is obstructed.

Standing on the threshold of the twentieth century, the progress in invention attests the scriptural phrase: "To him that hath shall be given." With all the accumulated lore and wealth of genius, the student of nature, of science and art may look out from the small beginnings that we call great, and, with a prophet's tongue, speak of greater results projected on the curtain of the future.

A. MALCOLM.

RECENT APPLICATIONS OF ACOUSTICS TO MEDICINE.

THE human machine does not run noiselessly. The attention of physicians has been attracted from the highest antiquity to borborygmus, noises of the muscles, beating of the heart, etc. In fact, auscultation has always been practiced, but it is especially since the time of Laennec, the inventor of the stethoscope, that this method of observation has entered into everyday medical practice. In principle, the stethoscope was a simple tube, one of the extremities of which was applied to the organ and the other to the ear. Half a century later, the instrument, in the hands of Collongues, became the dynamoscope. One of the extremities (that which receives the sound) was widened out more or less into a trumpet, and the auricular portion was also modified. The intermediate tube was sometimes made very long and sometimes very short, but, upon the whole, it was always the same principle of resonance that was applied, and the superiority of the various more or less complicated arrangements that have been constructed over the pure and simple use of the ear has not been demonstrated in all cases.

Along with auscultation, physicians have in all times practiced percussion.

Hippocrates, by striking the abdomen, was able to

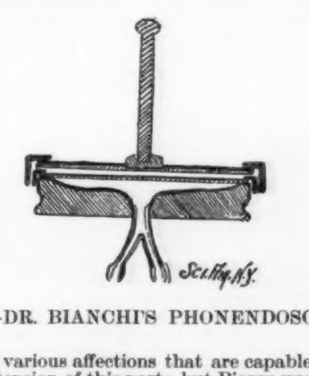


FIG. 1.—DR. BIANCHI'S PHONENDOSCOPE.

distinguish various affections that are capable of leading to a distension of this part; but Piorry was the first to interpose an apparatus between the organ and the finger that receives the shock. The plessimeter, which was highly successful and is still used by some physicians, is a simple plate of ivory from 1½ mm. to 2 mm. in thickness, of oval form, 5 cm. in length by 3 to 4 in width, and provided at its extremities with ears that permit of grasping the instrument. The plate is, as a general thing, graduated into millimeters. The instrument is moved over the skin, and it is thus possible, according to the variations in the resonance of the tissues, to outline, with more or less accuracy, the form of the internal organs, such as the spleen, liver, and heart.

An endeavor has several times been made to combine the stethoscope and plessimeter, so as to observe with some little precision the changes in the quality and intensity of the sounds emitted through percussion at

FIG. 2.—THE PLESSIMETER.

definite points of the skin. This was particularly the object of Dr. Boudet's stethoscope. The last and most perfect tentative in this direction is Dr. Bianchi's phonendoscope. This is a small metallic capsule about 6 cm. in diameter, closed by a thin disk of ebonite, and the cavity of which is put in communication with the ears through rubber tubes. To the center of a second ebonite disk, which covers and protects the first, is fixed a small rod 5 or 6 cm. in length, the free extremity of which terminates in a small button, as shown in the figure. When it is desired to explore an organ, the

FIG. 3.—AUSCULTATION BY MEANS OF THE PHONENDOSCOPE.

stomach, for example, the extremities of the rubber tubes are placed in the ears, the apparatus is grasped by its metallic part and the button is applied to the abdomen at a place where one is sure of the contiguity of the organ to the wall. Then, with a finger of the free hand, the skin is rubbed with a slight pressure. A centrifugal direction is the one that gives the best results. As long as one finds himself within the contours of the projection of the organ upon the wall,

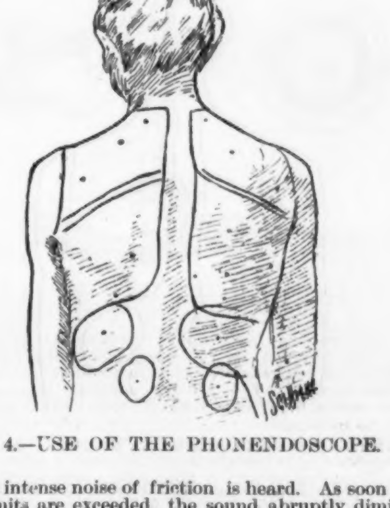


FIG. 4.—USE OF THE PHONENDOSCOPE.

quite an intense noise of friction is heard. As soon as these limits are exceeded, the sound abruptly diminishes in intensity.

It is thus possible to very accurately outline the contours of the empty stomach. Supposing that a glass of water be absorbed, the apparatus will immediately show the level of the liquid and the consecutive distortion of the organ. Provided the button rests upon the point of an organ, the apparatus permits of outlining

the contours of such organ, even if it be situated behind other viscera. In case of fractures of the bone, it is admirably adapted to the locating of the region where the break exists. This is another method of seeing through opaque bodies. Sometimes, in doubtful cases, it is advantageous to put one of the rubber tubes into the ear of another physician. The two practitioners can thus verify their perceptions.

The sensitiveness of the apparatus may be further increased by the use of two phonendoscopes, each being connected with the ear by a tube. The noise then flies abruptly from one ear to the other.

The applications of acoustics to medicine are still few. This is due in a large measure to the difficulty experienced in measuring the intensity of a sound. We have numerous photometers for measuring the intensity of light, but we possess no genuine sonometer. Mr. Charles Henry has just presented to the Academy of Sciences a very simple apparatus that permits of

FIG. 5.—USE OF THE PHONENDOSCOPE.

comparing, with an accuracy hitherto unknown, the intensities of two feeble sonorous sources. This he calls an audiometer. It consists of a copper tube 13 cm. in length by 5 in diameter, provided with a diaphragm, mounted upon a cast iron foot and containing a cardboard tube surrounded with wadding. At one end the instrument is provided with a copper plug traversed in the center by a small tube surrounded with rubber and that is introduced into the ear. The other extremity is provided with a rubber cap designed to contain a watch. The aperture in the diaphragm may be varied in size by acting upon a pinion through a small graduated button. The wider the diaphragm is opened, the intenser becomes the sound that reaches the ear. This principle has for a long time been applied in optics. The wider the aperture in the shutter of the camera, the greater is the intensity of the light that enters the interior. We have here a very simple method of measuring the sonorous intensities sufficient and necessary for a minimum perception, in a word, of ascertaining the sharpness of ear of a given subject. The smaller the opening that must be given the diaphragm in order to hear the tick of the watch, the acuter is the hearing. There is nothing easier, too, than to compare the sonorous intensity of two sources

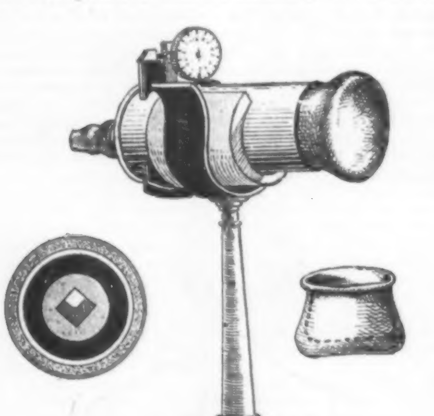


FIG. 6.—HENRY'S AUDIOMETER.

—of two watches, for example. It is only necessary to find what width of aperture in the diaphragm is necessary for a minimum perception for each of the sources. If, with the second source, the width of the aperture has to be doubled, it is because this second source is twice less intense.

In optics an endeavor has for a long time been made to ascertain how much light different bodies of the same thickness allow to pass. In acoustics the problem has never been proposed. We know that heavy tapestries of wool, velvet, etc., deaden sound very well, and the portieres of our studies are an application of this fact. But how do different building materials, the different woods and the different cements behave as regards sound? We do not know, but accurate data of this nature would prove very useful in modern architecture.

All such problems, as well as that of the measurement of the normal and pathological noises of the human machine, will possibly be solved with precision by the new audiometer. In the applications to clinics, the watch and its rubber cap are evidently useless. A deadening cushion should be employed when it is a question of using the audiometer directly as a quantitative and comparative stethoscope. We have here a new future for clinics furnished solely by French science.—Le Monde Illustré.

MEDIÆVAL MILITARY SURGERY.

IN the formation and dispatch of a military force at the present time, no matter whether it be a small "provisional battalion" or an army corps of the largest size, the equipment and provision of the medical branch is as complete, and, proportionately to the size of the force it accompanies, as large, as the supply and transport, the engineering department, or that of the combatant strength itself. In this, perhaps, more than in any other point, the contrast between the present conditions which obtain and the state of things at even comparatively recent times stands out with startling distinctness.

The first traces of field hospitals, or, as they were formerly described, "flying hospitals," appear to be in the recorded fact that the emperors Mauricius and Leo VI had along with their armies certain followers called deputati, who were distributed among the cavalry, and were obliged to carry off those wounded in battle. On this account they had on the left side of the saddle two stirrups, in order that they might more easily take up the wounded behind them, and for every soldier thus saved they received a certain reward. They were required also to carry with them a bottle containing water, for the purpose of reviving those who might have fainted through loss of blood. The works of Paracelsus, Thurneyser, and other ancient writers upon surgery show incidentally that they were present at battles and sieges, but certainly only as combatants and not as appointed surgeons. The field surgeons who accompanied armies in the beginning of the fifteenth century were rather for the use of the commanders and principal officers than for the service of the troops at large. Their numbers were too small, and as they were authorized by their commissions to receive booty and prisoners, and, like the knights, were obliged to bring with them archers, they were doubtless primarily combatants.

The appointment of regimental surgeons in the English army was, it is probable, coeval with their corps; but at what precise period it became customary to provide places for the reception of the sick or wounded is uncertain. The first authentic information on the subject is to be found in the writings of Drs. Monro and Brocklesby, both of whom flourished about the middle of the last century. The former, who seems to have examined the ancient writers with great care for information on the subject of military hospitals and the accommodation of the wounded, observes that no ancient author that he had met with makes mention of military hospitals.

From the writings of Livy, Tacitus, and others, it appears that it was the custom in ancient times to intrust the wounded after great battles to the hospitality of the neighboring gentry, which was often exercised to a very injurious effect. Dr. Monro, however, though he makes no reference to the first establishment of regimental surgery in the English army, speaks of military hospitals as well known in his time. "In times of war," says he, "when the regiment is ordered on actual service, the surgeon and his mate always go with it, and their duty is to take care of the sick and hurt in their own regimental hospital." Dr. Brocklesby, writing at about the same period, gives a lamentable picture of the treatment of sick and wounded soldiers, and concludes by observing that "to the important subject of military hospitals, neither Montecuculli, Folard, Fequieres, the great Conde, Marshal Saxe, Gen. Bland, nor any other writer with whom he was acquainted, had paid much attention, for officers in this respect conceived that they had little more to do than to consign the sick to the best of those accommodations which chance, necessity, or a base parsimony had assigned to them."

The establishment of properly organized surgical attendance for the army in the field in Germany appears to have been prior to the middle of the sixteenth century, for Frosberger, who wrote about that period, refers to this as then existing. According to his statement, there should be with the commander-in-chief a field surgeon-in-chief, a doctor, who had the inspection of the department, and "the barbers and their servants, whose duty it was to drag the wounded from the heaps of slain and to convey them to their masters." He also remarks that there ought to be with the artillery a general field surgeon, and a surgeon to each company, who should be "not a paltry beard scraper (bartscherer), but a regularly instructed, experienced, and well practiced man." The curious alliance between shaving and surgery which always obtained during the middle ages appears to have been fostered and even insisted upon by some governments, even up to the beginning of the present century. So late as 1801 certain Englishmen who had entered the Swedish navy as assistant surgeons were dismissed the service for refusing to shave the crews of their respective ships.—London Standard.

A simple rule is given in Textile Industries for making potash soft soap for engineers' lubricating purposes; the method pursued in this case is to dissolve twenty pounds of absolutely pure, fine, strong caustic potash in an iron or earthenware vessel, with two gallons of soft water, this strong lye being added to nine gallons of oil heated to about 140° F., pouring it in a small stream and stirring continually until the two are combined and smooth in appearance, some ten minutes being necessary, and the mixture may be done in a wooden barrel. After being wrapped in blankets to keep in the heat generated by the mixture itself combining and turning into soap, it is placed in a warm room and left for three days. The result will be 120 pounds of the finest concentrated potash soft soap, pure, free from adulteration. Any of the vegetable or animal oils will be found serviceable, but pale seal oil is found best for wire drawing and lubricating.

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